PAPERS

IN

MECHANICS.

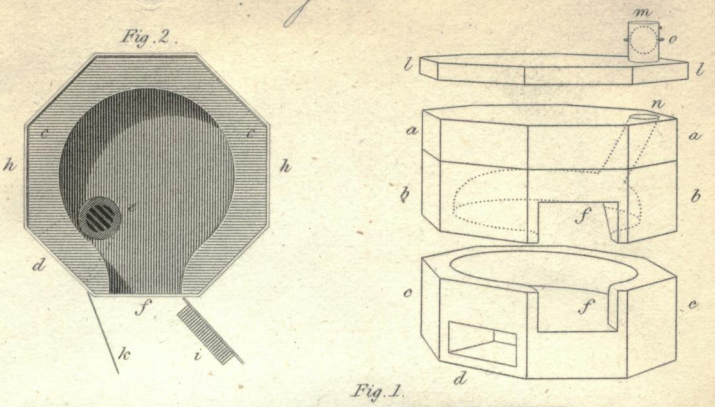
N° I.

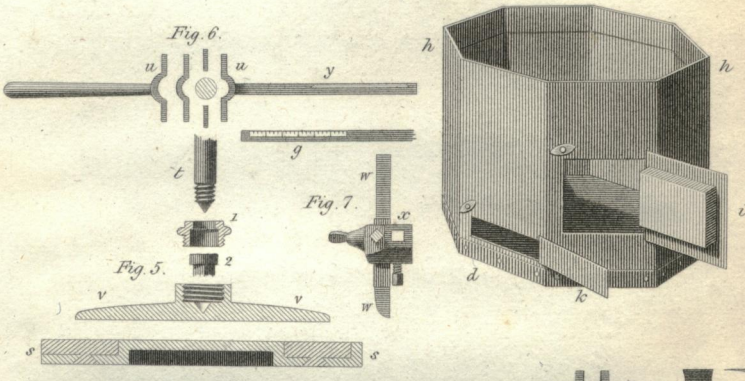
MACHINE FOR CUTTING TIPS FOR HATS.

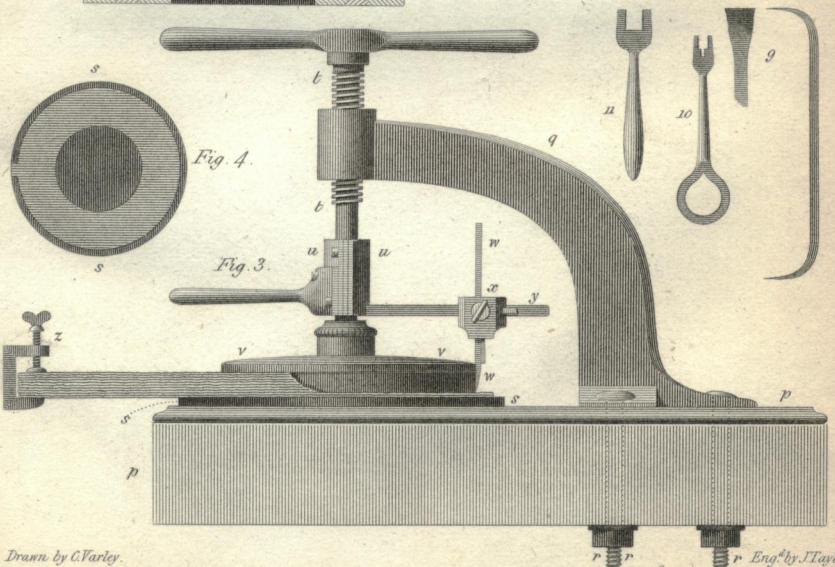
The sum of TEN GUINEAS *was this Session given to Mr.* BENJAMIN RIDER, *of Red-Cross-court, in the borough of Southwark, for a* MACHINE FOR CUTTING TIPS FOR HATS.

THE top of the crown of a hat, unless capable of more resistance than the other parts, would be peculiarly liable, from its exposed situation, to be beaten in and damaged, especially at the edges. In order to give the requisite strength in the cheapest and most effectual manner, the manufacturers are in the habit of fixing on the inside of the hat, beneath the top of the crown, two or more round pieces of stiff paper or pasteboard, which, in the language of the trade, are called *tips*. These tips are generally made by laying the hat-block on a sheet of paper or pasteboard, and by means of a pencil carried round the edge of the block, describing on the paper a circle of the proper size, which is afterwards cut out by a pair of

Mr. I. Storys, Portable Oven. Pl. 3.







Drawn by C. Varley. Engd. by J. Taylor.

Mr. Riders Machine for cutting Tips for Hats.

scissars. This method possesses the advantage of perfect simplicity, but consumes a considerable quantity of time; and as the tips thus made are never perfectly round, the support which they afford to the hat is unequal.

By Mr. Rider's machine, several tips may be cut at once of any required diameter, and of a truly circular outline. The price charged by the inventor for tips so cut is (exclusive of the cost of the paper or pasteboard) one penny per dozen. Leather for the tops of caps may be cut in the same manner, and the machine may no doubt be applied to various other similar uses.

The following CERTIFICATE was communicated by Messrs. Eveleigh, Hat-manufacturers.

To the Committee of Mechanics, Society of Arts—

Union-street, Southwark,
ESTEEMED FRIENDS; Second Month, 8th, 1821.

WE have made use of the tips for hats, cut by the machine of Benjamin Rider, and we so highly approve the same, that we are making arrangements to use none other in future.

We are very respectfully,

FRANCIS & SAM. EVELEIGH.

Reference to the Figures of Mr. RIDER's *Machine for Cutting Circular Tips for Hats, Plate* III, *drawn one-sixth of the real size.*

Fig. 3 shows a side elevation, *p p*, a strong wooden block, to which the iron arm *q* is firmly screwed by three screws,

r r r; *s s*, a circular iron plate, let into the block *p p*, about half its thickness, having a circular ring of pewter melted in it, to make a soft surface to receive the point of the knife (shown in fig. 4, and in section fig. 5); *t t*, the screw which presses down the pasteboards to be cut, on the nose of which, a gauge-plate, *v v* (suited to the size of the tips), is hung by the hollow screw nuts, shown separated in fig. 5; *u u*, a tube formed of two semi-cylindrical pieces, or saddles, which carry the handle and square arm *y*, and are fitted by screws, to move easily on the cylindrical part of the screw *t* (shown separated in fig. 6), by which means the knife *w w* is kept steady, and obliged to advance perpendicularly through the pasteboard, while it revolves round the screw *t* as a centre; *x*, the sliding block on the arm *y*, which carries the knife *w*, and fixes it to cut tips of any required diameter, shown also in fig. 7, an ivory scale being let into the arm *y*, to regulate the diameter of the tip; *z*, a clamp (two of which should be used) to hold the pasteboards together, till all the circular tips are cut out of them; fig. 9, a scraper to take the burs off the surface of the pewter; 10 and 11, keys to turn the nuts and screws; fig. 5, 1 the nut, which goes easily over the cylindrical part of the screw *t*, and is kept up by the nut 2, which goes into the nut 1, and screws on to the screw *t*; and the nut 1 having a screw on the outside, screws into the neck of the gauge-plate *v v*, whereby the gauge-plate hangs on the nose of the screw *t*, so as to rise and fall with it); the conical point of the screw *t* comes through the nut 2, and this point enters the answering centre of the gauge-plate *v v*, and (while pressing it down on the pasteboards) secures its being concentric with the screw *t*: there is sufficient shake in the nuts 1 and 2, to enable the plow-knife to keep correctly close to the gauge-plate *v v*, and to cut the tips perfectly clean.

N° II.

PORTABLE OVEN.

The small or Vulcan SILVER MEDAL *was this Session voted to Mr.* JAMES STORY, *of Theobald's-road, London, for a* PORTABLE OVEN. *The following communication has been received from Mr.* S. *and a model of the Oven is placed in the Repository of the Society.*

15, Theobald's road, late Swallow-street,
SIR; May 19th, 1821.

PERMIT me the honour of requesting you to be the medium of conveying to the Society for the Encouragement of Arts, Manufactures, and Commerce, my most grateful thanks for the distinguished token they have been pleased to bestow of their approbation of my humble efforts, in the construction of the Portable Stone Oven. I have also to request that you will do me the favour of stating my perfect acquiescence in all those terms which are contained in your letter of the 30th ult. I have the pleasure of inclosing the statement of the advantages attending the use of the oven in question.

I am, Sir,

A. Aikin, Esq., &c. &c. &c.
Secretary, &c. &c. JAMES STORY.

The common dimensions of my portable stone oven are the following, viz. 2 feet 6 inches wide, 2 feet 3 inches high. It is composed of Reygate firestone, cased with iron. It requires no separate compartment for the fuel, which must be placed in the cavity of the oven, and be renewed from time to time, till the stone is heated white hot internally. This will take place in an hour and a half, and will employ about a peck of coals, the oven being previously cold. If it still remains warm (for it will be a long time in growing quite cold), the consumption of fuel will of course be proportionably less. When the oven is become sufficiently hot, the door of the ash-pit and the chimney are to be closed up, and the bread, &c. to be introduced.

The weight of the oven is 6 cwt., and the price charged for it is 20*l.*

It was used by Captain Parry, on board the Hecla, in the Winter 1819-20, as appears by the annexed

CERTIFICATE.

London,
January 11th, 1821

SIR;

In reply to your letter of the 8th instant, desiring to know my opinion of the portable stone oven, embarked on board the Hecla, on the late expedition to the Polar regions; I have to acquaint you, that it was constantly used during the Winter of 1819-20, upon the main hatchway of the Hecla's lower-deck, answering the purpose of baking the ship's company's bread, and of warming the deck in part during that period. It is, therefore, my intention, should no better mode be offered by the numerous persons now applying for

that purpose, to use the ovens in question, in the same manner as before, on board the ships now equipping for the Polar seas.

I am, Sir,

&c. &c. &c.

W. PARRY.

Reference to the Engraving of Mr. STORY's *Oven,* Plate III.

Fig. 1 shows the oven taken out of the iron case, and the parts separated; *a a* and *b b* are two fire-stones, which are cemented together and form the dome of the oven; in consequence of this arrangement, if one or both of them crack from the heat, the fractures will most probably not coincide, and the part will not fall to pieces; *c c*, the lower part or floor of the oven, having an ash-pit at *d* to admit air to the fuel through the grate *e*, fig. 2; *f f*, the mouth; *h h*, the iron case which holds the stones together, and into which they are cemented; *i*, the door lined with stone; *k*, the door of the ash-pit; *l l*, the iron cover, with a chimney *m*, coinciding with the opening *n*, in the stone *a a*; *o o*, a damper in the chimney *m*.

Fig. 2, a plan of the iron case *h h*, and of the floor *c c*. The parts are drawn to $\frac{1}{24}$ of the real size.

N° III.

METHOD OF CORRECTING THE LOCAL VARIATION OF A SHIP'S COMPASS.

The large GOLD MEDAL *and a complete Set of the Transactions of the Society were this Session voted to Mr.* PETER BARLOW, *Professor at the Royal Military Academy, Woolwich, for his improved* APPARATUS FOR ASCERTAINING THE LOCAL INFLUENCE OF A SHIP'S GUNS, &c. ON THE COMPASS. *The following communication has been received from the candidate on the subject, and a Model illustrative of his apparatus, is placed in the Repository of the Society.*

Royal Military Academy, Woolwich,
November 13th, 1820.

IN a mercantile nation like Great Britain, every attempt to improve the practice of navigation, and to diminish its dangers, is entitled to the favourable consideration of the public, and when in those attempts an individual has succeeded in developing any new and useful principle, the more that principle is known, the more rapid will be the consequent improvement. As the Society of Arts, &c. is ever ready to sanction with its approbation and to encourage with its re-

ward every useful invention or discovery, I feel very desirous of submitting to its notice a method which I have proposed for correcting the local attraction of a ship's guns, and other iron on the compass; a subject which has for some years engaged the attention of the most able navigators and philosophers of this country.

That the guns, ballast, and other iron in vessels of any description, and particularly in ships of war, should have an influence in disturbing the natural direction of the compass, seems now so obvious, that we are astonished it did not long ago attract the attention of the many able English navigators, whose names do honour to the country which gave them birth; yet so far was this from being the case, that when the circumstance was first noticed by Mr. Wales, in one of his voyages with captain Cook, neither the one nor the other of these intelligent observers was able to account for the anomaly they had detected. They found that with the ship's head on different points of the compass, the needle pointed in different directions, deviating as much as 5°, 6° or 7°; but the cause of the anomaly remained unaccounted for, till captain Flinders at length discovered it to be caused by the local attraction of the iron of the vessel, and to be dependent as to quantity and direction on the dip of the needle.

The more recent observations of Mr. Bain, who has published a very useful work on the subject,* and of captains Ross and Sabine in their voyage of discovery towards the North, have confirmed, in a great measure, preceding deductions, and have shown the great necessity of devising some method of correction. In Baffin's Bay, the local attraction was so considerable, as to cause a deviation of nearly 50°, according as the observation was made with the ship's head pointing to the

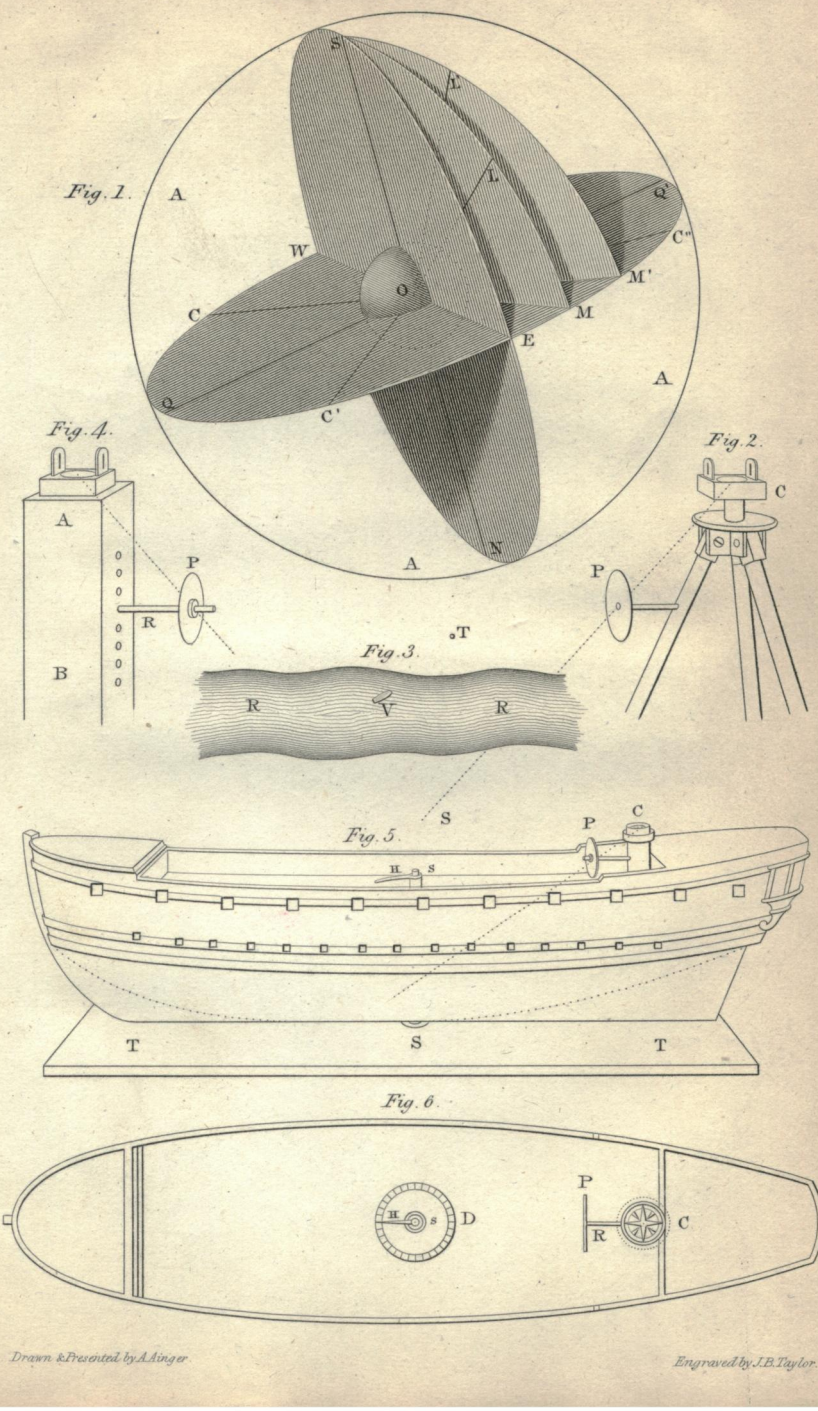
* Bain "On the Variation of the Compass."

east or west. Hence there no longer remained any doubt, that the law laid down by captain Flinders is, generally speaking, correct, viz. that the quantity of local attraction depends upon the quantity of the dip, and that the effect is also produced in opposite directions, accordingly as the vessel is in the southern or northern hemisphere of the globe; but at the same time these observations demonstrated, that the ratio of this increase or decrease, which he had assumed was entirely erroneous.

At the same time, however, that these observations demonstrated the inadequacy of captain Flinders's rule, they did not answer the purpose of establishing any new rule more accurate. Indeed, every one had deceived himself by assuming the east and west points to be those of greatest attraction; whereas, as will appear in this paper, those points, in certain places of the earth, are actually points of no attraction; up to this time, therefore, every thing was inaccurate and uncertain, both as it related to the determination of the quantity of deviation, at different points of the compass, and at the same points in different parts of the earth.

In this state of the inquiry, I commenced a series of magnetical experiments, in the beginning of the year 1819, and was so fortunate as to discover two important facts, which promise to throw considerable light upon this hitherto mysterious subject. The one is, that in every mass of iron there is a *plane of no attraction*, viz., a plane, in which a compass being placed, *the iron has no effect upon the needle.* This plane passes from the magnetic north point, to the south, and in this latitude inclines to the horizon, at an angle of 19° 24′, being the complement of the dip. The other is, that the attraction of iron on the compass depends wholly on the surface of the former, and is independent of the mass or quantity. I also discovered other laws of action, founded upon

Illustrations of Mr. Peter Barlow's method of ascertaining the influence of the Ships Iron on the Compass. Pl. 2.



Drawn & Presented by A. Ainger

Engraved by J.B. Taylor.

these two, which are explained in my "Essay on Magnetic Attractions," a copy of which I have done myself the honour of transmitting with this memoir, begging for it the acceptance of the Society of Arts.

The nature and properties of the plane of no attraction, and of the other laws which result from this fundamental fact, will be best illustrated by referring to fig. 1, Plate II. In this figure O is supposed to represent an iron ball and A A A a sphere within its influence, the points S Q N Q′ being in the meridian. The line N S′, contained in the plane S E N W, denotes the natural direction of the dipping needle in these latitudes, its inclination from the horizon being about $70\frac{1}{2}°$. Now, conceiving Q E Q′ W to represent a circle or plane passing through the centre of the ball and perpendicular to the axis N S, it will be the plane of no attraction, which has this remarkable property, that if lines be drawn in it, as, for example, the lines O C, O C′, O C″, and a compass be placed any where in those lines, or in short in any point of the plane Q E Q′ W, it will be uninfluenced by the iron ball, and will preserve its natural magnetic direction. But as soon as the compass is removed out of this plane, the needle is found to deviate from its original bearing, its south end being drawn towards the ball when the compass is placed below the plane Q E Q′ W, and the north end when it is above; in all these cases the quantity of deviation follows a determinate law. Suppose two other planes in the sphere A A A, each passing through the centre of the ball, and each perpendicular to Q E Q′ W, of which let M O S L, M′ O S L′, represent quadrants. Now supposing a compass placed in each of these planes, somewhere in the lines O L, O L′, but equidistant from O, then the tangent of the deviation of the compass in O L will be to that in O L′, as the rectangle of the sine of twice the arc L M, and the cosine of the arc E M, is

to the rectangle of the sine of twice L′ M′, and the cosine of E M′ (E being the east point of the horizon), so that the deviation being known for any one situation, it may be computed for any whatsoever.

Having established the above laws, by the most satisfactory experiments, I next ascertained the law for different distances, finding it to be very accurately as follows; viz., the tangent of the deviation is inversely proportional to the cube of the distance, the angular position being the same.

And when different iron balls are employed, the tangent of deviation is directly proportional to the cube of their diameters. But what is the most remarkable is, that notwithstanding the above law seems to indicate that the tangents of deviation are as the masses, yet balls and shells, whatever may be the thickness of the latter (provided it be not less than $\frac{1}{20}$ of an inch), having the same external diameter, give the same results.

The power of attraction, therefore, resides wholly on the surface, and the law becomes, *the squares of the tangents of deviation, are directly proportional to the cubes of the surfaces.* Lastly, I ascertained that all those laws which were deduced from experiments on balls and shells, have equally place in iron bodies of the most irregular forms, and ultimately in ships of war carrying the usual equipments of such vessels.

Hitherto I had proceeded on the foundation of experimental results, and had carefully abstained from advancing any thing which might be considered hypothetical; but seeing the beautiful uniformity and simplicity of the laws above stated, I could not refrain from concluding, that the remarkable fact of the plane of no attraction being perpendicular to the direction of the dipping needle, was not accidental or peculiar to these latitudes, but that the same had place in every part of the world; and it was on this ground I proposed the method which I have

endeavoured to explain for correcting the local attraction of vessels. It is clear, however, that, independent of observations in other parts of the world, this conjecture, however reasonable and probable, could not be received amongst the established principles of magnetism; and I therefore esteem myself highly fortunate in having lately found that Mr. P. Lecount has been carrying on a course of experiments, in some measure similar to my own, on board H. M. S. Conquereur; and by attentively observing the various phenomena presented by iron bodies on the magnet, in his passage from St. Helena to England, he has most satisfactorily demonstrated, the accuracy of my deduction relative to the varying position of the plane of no attraction in different latitudes, but at the same time wholly independent of any thing I had done, and indeed without being aware that such a work as mine had ever been published.*

One serious difficulty, however, still remained; namely, that all these laws had reference to the dip of the needle, which it is perhaps impossible to ascertain at sea, while the vessel is in motion; and I was therefore led to seek for some method by which this difficulty might be avoided, and it is this practical and mechanical principle which I am desirous of explaining to the Society of Arts; not in its original, but in its improved form. Since the iron of the vessel and the compass maintain the same relative situation with respect to each other during the voyage, and since all the action of the iron may be considered, like that of every other attraction, to be reducible to one common centre, or, in the language of mechanics, to "one resultant," it is obvious, that the effect produced by the distributed iron, is the same as that which would take place from a single large globe of iron, of which the centre should

* See Lecount "On the Polarization of Iron."

coincide with that centre of attraction. And since a small ball of iron at a small distance, will produce precisely the same effect as a larger ball at a distance proportionally greater; if we consider a line to be drawn from the compass to the centre of attraction of the vessel, and if we fix in that line, but nearer to the compass, a small ball or plate of iron, the action of the latter will be the same as that of the former (the distance being properly adjusted); and being so in one situation, it must continue so in all, because the line joining the centre of attraction with the pivot of the needle will be constantly fixed, as regards the vessel itself, at all times and in all parts of the world.

To be a little more particular in my description, let C (fig. 2 Plate II.) represent an azimuth compass in a certain situation in the vessel, viz. one selected for making observations on the sun's amplitude and azimuth,* and let S be the centre of attraction of the iron of the vessel; let also P represent a plate of iron, having its centre in the line joining S and C, which let us suppose to be fixed at such a distance, that its action on the compass may be the same as that of the iron at S; then it is obvious, since the plate, the compass, and the vessel all move together, that it will continue in all directions of the vessel and in all parts of the world, to produce the same effect as the distributed iron, whatever change may take place in the dip, and in the magnetic intensity. This, then, constitutes the principle of my method of correction, viz.

When a vessel has received on board her guns and stores, let her be warped round point by point, to ascertain the quan-

* Formerly azimuth and amplitude observations, were made in any part of the vessel, but since the effect of the local attraction has been known, navigators are acquiring the habit of taking them at a certain fixed place.

tity of her local attraction,* and let the situation of the plate be determined (by the directions that follow), so as it may produce the same effect as the iron of the ship; and consequently, so that when the plate is applied, the effect may be doubled. This being done, let the plate be laid aside, and when at any time it is desirable to ascertain the effect of the guns, &c. on the compass, let it be applied to its assigned situation, and observe how many degrees, &c. it attracts the needle out of its prior direction, and just so much will the guns have drawn the same from its true magnetic bearing before the experiment. This being ascertained, and the course of the vessel corrected accordingly, the plate is to be removed and laid aside, till some new circumstance renders its application again necessary.

These directions, however, must be considered as only applicable when the plate is attached to the binnacle compass, as I have proposed in my Essay; when it is applied to the azimuth compass (the improvement to which I wish to draw the attention of the Society), the directions are then somewhat different, although the principle is the same.

Before I describe these, I should observe, that having laid the above proposition before the Admiralty, and my communication being by that board submitted to the Secretary of the Board of Longitude; and Sir George Cockburn, Mr. Croker, and some other gentlemen belonging to the Admiralty, having done me the honour to be present at a series of my experiments on the 24 pounder above mentioned, orders were immediately given for trying them on board some of H. M. ships. It was in consequence of my experiments on board H. M. S. Leven, and profiting by the practical and theoretical knowledge of her officers, that I changed the application of the

* See Note 1.

plate, from the binnacle to the azimuth compass, as being more susceptible of nice observation, besides possessing other advantages, not to be obtained in the former case.* The following are the directions which I left with captain Bartholomew and the other officers of that ship, for using the plate:

When an azimuth, or amplitude of the sun, or any other heavenly body, is taken for the purpose of determining the variation, the observation is to be made as usual, and immediately repeated again with the plate attached, and the difference in the two bearings will be the local attraction.

For example: Suppose the first observed bearing to be 67°, and the same with the plate attached 70° 30′; then

° ′		° ′	
70 30		67 0	
67 0		3 30	
3 30	local attraction.	63 30	correct azimuth.

Again: Let the amplitude, by observation, be 13° 30′, but with the plate only 10° 30′; then

° ′		° ′	
13 30		13 30	
10 30		+3 0	
3 0	local attraction.	16 30	true compass amplitude.

At other times, to find the local attraction, take the bearing of the ship's head or of any other part of the vessel by the azimuth compass; then observe the same again with the plate attached,

* See Note 2.

and the difference will be the local attraction, it being understood that, in all cases, when the first observed bearing is diminished by the plate, the difference is to be added to the first bearing; and when the first angle is increased by the plate, the difference is to be subtracted.

These are all the directions which are necessary for using the plate, and I trust they are such as cannot be misunderstood by any seaman, entitled to be considered as a practical navigator.

Similar experiments were made by order of the Admiralty, on board H. M. S. Conway, captain B. Hall, and the same directions given; but as this vessel is now upon a long and interesting voyage in the southern hemisphere, it may be some considerable time before I hear from her able and scientific commander.

From the Leven I have already received the most satisfactory account, by a letter from Lieut. Mudge (who, with the other officers of that ship, took the greatest interest in the subject), an extract of which I have annexed to this memoir.

It now only remains for me to describe the nature of the plate and the mode of adjustment. As to the plate itself, it consists only of a circular piece of iron, having a hole and socket in its centre, for placing it upon its pin; or it may consist of two thin plates* screwed together, having a thin piece of board between them: this, however, is only for the sake of correcting slight inequalities, and for giving it some thickness without increasing its weight, in order to prevent its being bent by any fall or blow. A plate of twelve inches diameter, and weighing about four or five pounds, is sufficient for correcting the local attraction of any ship in the navy, its distance from the pivot varying from thirteen to sixteen inches, according to the power of attraction in the vessel.

* See Note 3.

The best method of determining the proper situation of the plate is to proceed as below:

First, warp the vessel round point by point, and on each point take the bearing of an object on shore, while a person on shore, from the same spot, is taking the bearing of the compass on board; by which means it is obvious the local attraction at every point will be ascertained; for, independent of the latter, the bearings at each observation ought to be diametrically opposite, or differing by 180°; and what the difference exceeds or falls short of this, is due to the action of the iron on board.

This being determined, let a log of wood (A B, fig. 4) having no iron about it, be taken on shore, and let holes be bored in it at 8, 9, 10, &c. inches from its top, to receive the brass horizontal rod R, which is to carry the plate; this pin being inserted in one of the holes, and the compass set on the top of the log, place the plate on the pin, at any distance (as shown in the figure); now turn the log about point by point, and by removing the plate from the pin at every observation, ascertain the deviation produced by the iron; then, if these deviations, at every point, be the same as those found to obtain on board, the plate is properly adjusted; but if this should not be the case (as is the most likely to happen), shift the height and distance of the plate, and try the same again, and after a few trials, the exact position will be determined, so that the deviations on board, and on shore, agree with each other.* This being done, measure very accurately the depth of the centre of the plate below the pivot of the compass, and its distance from the vertical passing through the same; then cause a hole to be bored, and a socket to be introduced into one of the legs of the tripod used for the azimuth compass on board, so that when the brass pin is inserted, as shown in fig. 2, the centre of

* See Note 4.

the plate may be at the same depth below, and distance from the vertical passing through the pivot of the compass, as was determined on shore, and it will be the fixed situation required. The plate and pin are of course both moveable, and are laid aside except at the time of making the observations above described.* It only remains to add, that as it is important that the place of observation in the vessel should be constantly the same, it will be advisable to have three small holes made in the deck for fixing the position of the feet of the tripod.

If, as may sometimes happen, the observations cannot be made from this fixed station, it will be to no purpose employing this plate; and all that can be done will be to repeat the observation again in the proper place the first opportunity.

Extract of a letter from Lieut. MUDGE, *of H. M. S. Leven, to Mr.* BARLOW, *Royal Military Academy.*

H. M. S. Leven,
DEAR SIR; Teneriffe, Santa Cruz.

I CANNOT resist the pleasure the writing to you affords me, and I trust if you should think my communication rather premature, you will excuse it, and attribute it to the pleasure I derive from your invention carrying me beyond my bounds. I shall state in full detail all the circumstances which relate to your plate and compass,* as I think you will be pleased to hear how admirably it has succeeded in every respect.

I have found in every instance, that, with the assistance

* See Note 5.

† The compass here alluded to, is one made by Messrs. Gilberts 148, Leadenhall-street.

of the plate, the true variations are very closely determined, which is of course a great object. I have a register of the whole, which I shall send on our return.

" In consequence of our finding an extraordinary error in the two compasses by which we steer, occasioned by local attraction, I have made a point of comparing them with your plate and compass on every point we steered, and of registering their difference. In some instances I have found the deviation by the starboard compass 8°, and greatest when the ship's head is south, which appears to arise from the mass or quantity of iron which is abreast of the compass, and perhaps the centre of attraction, when a compass is placed there, may lie in the side abreast; but it matters little, as your plate has, and I make no doubt will always detect the error. I shall relate a circumstance where we detected such an error in one of the compasses, arising from local attraction, that might have been the cause of the ship being wrecked had we been amongst shoals or rocks.

On the 22nd of May, at noon, we were in latitude 41° 46′ N., and long. by chronometer 9° 53′ W.; taking this as our departure, we sailed by the starboard compass S. 46° W. 183 miles; this placed the ship on the 23rd, allowing the variation 21° W. in latitude 38° 58′ N. and longitude 11° 26′ W. Whereas the observations at noon for latitude, and sights in the morning for longitude, gave lat. 38° 39′ N., and long. 10° 58′ W; so great a difference in 24 hours was attributed to a current, till I compared the starboard or steering compass with the one with your plate, when I found no less than 7° error, to be subtracted from the course steered, making the true course S. 17° W. instead of S. 24 W. which had been taken as correct; by allowing the 7° which we found subtractive from the course, our latitude was, by reckoning,

38° 41′ N., and long. 11° 02′ W. which agree with observation as close as we can ever expect it to do under any circumstances.

Believe me, Sir,
&c. &c. &c.
WM. MUDGE.

Such is the present state of this method for correcting the local attraction of vessels, which, to be generally useful, must be rendered public, and nothing will more facilitate this object, if it should meet the approbation of the Society of Arts, than giving the present memoir a place in one of the volumes of its transactions; and I am in hopes, when the importance of the subject is considered, it will not be deemed unworthy of such a distinction.

PETER BARLOW.

NOTE 1.

THE method of warping a vessel about, under different circumstances, will suggest itself to any practical navigator; at the same time, it may not be improper to describe here the process as it was practised on board his Majesty's ships Leven and Conway, which differs, in some respects, from the method usually followed, namely, that of taking the bearing of a distant fixed object. The objection to the latter is, that the swinging of the vessel will always produce a greater or less parallax, which it is impossible to estimate correctly.

Extract from a Report to the Admiralty, relative to the Experiments made on board H. M. S. Leven. By PETER BARLOW.

April 19th, 1820.

THE Leven having dropped down to Northfleet on the 15th instant, I went down on the 17th, for the purpose of making a series of observations before the guns should be brought on board; these observations were conducted as below:—

First, finding that there would be great difficulty in warping the vessel round in the tide way of this place, I proposed and it was agreed to proceed in the following manner:

I took on shore an excellent azimuth compass, by Messrs. W. and J. Gilbert, which I had procured for the purpose, as also a theodolite by Schmalcalder. With the azimuth, the bearing of a distant object was taken, and found to be N. 35° 50′ E., and the theodolite was then adjusted to the same reading, viz. 35° 50′ from zero, by means of which the zero of the theodolite was brought to the true magnetic north, and consequently the bearing of any object might now be determined without any farther reference to the needle. It will of course be understood that the theodolite was fixed immediately over the spot where the azimuth compass was first erected.

The latter instrument was now taken on board, for the purpose of the experiments, while Lieut. Mudge remained on shore to take the bearing of the pedestal,* or pillar, on board with the theodolite.

The ship now beginning to swing to the tide, the word was given "look out;" at which signal Lieut. Vidal, at the

* Captain Bartholomew had ordered a pedestal to be erected just before the mizen-mast, as a fixed situation for taking his azimuths during the voyage.

azimuth compass on board, kept Mr. Mudge, on shore, in the line of the sights, while the latter gentleman kept in the same way, Mr. Vidal in the field of his telescope. Being thus prepared, the word "stop" was given, at which, each registered the bearing of the other at the same instant. These bearings, independent of the local attraction of the vessel, ought to have been diametrically opposite, and consequently the difference between the two readings, was the error due to the attraction of the iron on board.

The first observation being registered, the word "look out" was again given, and then the word "stop," and the same was repeated as often as possible while the vessel was swinging, Lieut. Boldy taking every time the bearing of the ship's head, by the ship's azimuth compass at the capstan. The advantages of this method are, that both bearings, viz. on board, and on shore, are made to depend upon the same compass, and thus the errors arising from the use of different needles are avoided, as are also those arising from the parallax of a distant object while the vessel is swinging, a source of error which must have attended all former observations of this kind.

The only thing actually necessary in this case is a fine free azimuth card and needle: those commonly served out to the navy are so sluggish, that it is impossible (while there is no motion in the vessel) to depend upon their settling within 2°. or 3° of the true magnetic north.*

The experiments above referred to were made before the guns were got on board; but the same were again repeated on the 19th of April, after they had been all shipped. The following are the results of both series of observations:—

* A reference to fig. 3 may render this description a little more intelligible, by supposing V the vessel in the river R R, and T the station of the theodolite on shore.

Experiments on board H. M. S. LEVEN, *at Northfleet, April* 17*th and* 19*th,* 1820, *by Mr.* BARLOW *and the Officers of the above vessel.*

GUNS NOT ON BOARD.			GUNS ON BOARD.			
No. of Experiments.	Bearing of Ship's Head.	Difference in Bearing or Local Attraction.	No. of Experiments.	Bearing of Ship's Head.	Difference in Bearing, or Local Attraction.	Local attraction shown by the Plate.
1	N 77° 0′ W	— 2° 22′	1	N 71° 0′ W	— 2° 51′	—
2	N 68 30 W	— 2 25	2	N 64 0 W	— 2 07	2 20
3	N 57 0 W	— 1 37	3	N 57 0 W	— 1 39	-
4	N 47 0 W	— 1 54	4	N 47 0 W	— 1 45	-
5	N 32 0 W	— 1 12	5	N 31 0 W	— 1 39	1 30
6	N 20 0 W	— 1 20	6	N 24 0 W	— 1 10	1 0
7	N 14 30 W	— 0 12	7	N 15 0 W	— 1 19	-
8	North.	+ 0 15	8	N 6 0 W	— 0 17	0 40
9	N 5 0 E	+ 0 54	9	N 4 0 W	+ 0 8	-
10	N 16 0 E	+ 1 32	10	North.	+ 0 24	0 0
11	N 32 0 E	+ 1 48	11	N 5 0 E	+ 0 11	-
12	N 45 0 E	+ 2 25	12	N 13 0 E	+ 0 29	0 40
13	N 52 0 E	+ 2 26	13	N 23 0 E	+ 0 46	1 0
14	N 67 0 E	+ 3 15	14	N 57 0 E	+ 1 27	1 30
15	N 74 0 E	+ 3 6	15	N 59 0 E	+ 2 32	-
16	N 83 0 E	+ 2 31	16	N 72 0 E	+ 2 23	2 10
17	East.		17	N 80 0 E	+ 2 51	-
18	S 81 15 E	+ 2 34	18	S 86 0 E	+ 2 11	2 30
19	S 75 30 E	+ 2 30	19	S 85 0 E	+ 2 34	2 30

The rapidity and force of the tide at Northfleet, prevented our warping the vessel about point by point, which is doubtless the best way. This, however, is easily practised in Portsmouth Harbour, where the above experiments were again repeated by the officers of the Leven, and the plate ultimately adjusted to the latter results, which as I am informed by Lieut. Mudge, somewhat exceeded the above.—The following experiments were made according to the latter method, on board H. M. S. Conway by order of the Admiralty.

Experiments on the Local Attraction of H. M. S. CONWAY, *Portsmouth Harbour, July 24th* 1820, *by Captain* BASIL HALL, *and Mr.* BARLOW, *of the Royal Military Academy.*

Dip, 70° 30′ 3.

No. of Mean Observations.	Direction of Ship's Head.	Observed Bearing of the Station on Shore, from the Ship, by Capt. Hall on Board.	True bearing of the Station on Shore, from the Ship as observed by Mr. Forster on Shore.	Local Attraction.	No. of Mean Observations.	Direction of Ship's Head.	Observed Bearing of Station on Shore by Captain Hall.	True Bearing observed by Mr. Forster.	Local Attraction.
1	S b E	N97° 0′E	N 95°40′E	+1° 20′	17	SS E	N 97 0′E	N 97°15′E	−0° 15′
2	South.	96 0	94 3	+1 57	18	SE b S	95 50	96 22	−0 32
3*	S b W	95 20	92 57	+2 23	19	S E	94 10	95 16	−1 6
4*	S S W	95 10	92 19	+2 51	20	S E b E	93 20	94 24	−1 4
5*	SW b S	94 8	91 0	+3 8	21	E S E	91 0	92 30	−1 30
6*	S W	94 2	90 47	+3 15	22	E b S	89 30	91 52	−2 22
7*	SW b W	93 35	90 15	+3 20	23	East.	87 50	91 15	−2 25
8	W S W	93 30	88 32	+4 58	24	E b N	85 0	89 5	−4 5
9*	W b S	92 10	87 32	+4 38	25*	E N E	83 20	86 34	−3 14
10	West.	-	-	-	26	N E b N	82 10	85 31	−3 21
11	W b N	88 0	84 25	+3 35	27	N E	82 15	84 58	−2 43
12	W N W	86 35	83 12	+3 23	28	NE b N	83 0	85 13	−2 13
13	NW b W	85 20	82 27	+2 53	29	NN E	85 50	88 4	−2 14
14	N W	83 25	81 46	+1 39	30	N b E	84 40	85 47	−1 7
15*	NW b N	84 17	82 7	+2 10	31*	North.	83 0	83 7	−0 7
16*	NN W	83 35	82 3	+1 32	32*	N b W	82 28	81 38	+0 50

1. All the numbers in the preceding Table marked thus,* are those in which two or more observations were made at the same point, and the mean of the two taken. In the others, we had not an opportunity of making more than one observation.

2. Where the apparent, or observed easterly bearing *exceeds* the true easterly bearing, the error or local attraction is marked + (plus); and when the former is *less* than the latter, the error is marked — (minus).

3. With the ship's head at west, the object on shore could not be seen.

Note 2.

It may be proper here to offer a few remarks on the advantage which will, I conceive, arise from attaching the plate to the azimuth instead of to the binnacle compass.

In the first place, as there are always two binnacle or steering compasses placed abreast of each other, they must necessarily be situated either very considerably out of the fore and aft line of the vessel, or be placed so near as to influence each other's direction.

For these reasons, these compasses seldom agree with each other; viz. in the latter case, in consequence of their mutual action, and in the former, on account of each being exposed to a different system of local attractions. Therefore, to render the method which I have proposed in my Essay effective, two plates must be employed, viz. one to each compass. Moreover the motion of the vessel renders exact observations on these compasses very difficult, if not impracticable. Whereas, with a good azimuth compass, the nicest obser-

vation may be made, and the slightest deviations detected; to which we may also add, that the direction of the needle being, with this instrument, determined by observation on a distant object, as, for example, the Sun, no error will arise from a change in the direction of the course during the observation; while in the other case we have no mark of direction but the *lubber-line*, which is, we may say, in nearly a continual state of oscillation, from the corresponding motion of the ship itself.

Note 3.

In my Essay I have described the plate as being *double*, and those which I have sent out in the Leven and Conway are of that kind. But I have since found that a single plate may be very safely employed, provided we give it sufficient thickness.

The double plate was employed by me in consequence of observing, that in very thin sheet iron, certain parts contained a degree of partial magnetism; and by using two plates, and ascertaining their strong and weak points of attraction experimentally, and combining them accordingly, viz. the weak point of one in contact with the strong point of the other, these partial actions were neutralized. But by using iron, weighing about 6 lbs. to the square foot, the double plate may be dispensed with, the partial action in sheets of this thickness producing no anomalous effect upon the needle, at the distance at which they are placed in the experiment.

Note 4.

In reference to the directions for fixing the plate, so that it may give the same errors as the ship at every point of the compass, it may be proper to observe, that in the trials by which this is effected, it will be sufficient to attend to these deviations at three points only, besides the north and south; for if the deviations caused by the plate, are the same as those given by the vessel at any three points in one semicircle (besides those corresponding to the meridian), they must necessarily be the same at every point. It will, however, be proper to make choice of three points, at some distance from each other, that the change may be rendered the more obvious. I generally use the East, NE. by N., and SE. by S.; for if we take points nearer to the north or south, the deviations are too inconsiderable to render the increase or decrease arising from a change of position sufficiently obvious. It will in course be the same if we use the West, NW. by N., and SW. by S. for this purpose.

After all, however, this is by far the most difficult part of the process for persons wholly unacquainted with magnetical experiments, and the best way in such case, will be to purchase a plate already corrected, that is, a plate whose effect has been experimentally determined for various positions and distances. Then, having warped the vessel about point by point, and determined its local attraction, it will only be necessary to select from the table delivered with the plate, the series of deviation agreeing with those of the vessel, and opposite to that series are placed the proper distance, height, and positions which the plate ought to have, in regard to the compass to which it is to be applied.*

* Plates, with the requisite Tables, may be had of Messrs. W. and J. Gilbert, Mathematical Instrument-makers, 148, Leadenhall-street.

It is only necessary to observe, that the table alluded to will only answer while the dip of the needle, at the place where the experiments are made on the ship, and at that place where the plate is adjusted, are the same or nearly so. In order to ascertain how far any correction was necessary in this respect for the various British ports, I solicited permission of the Honourable Commissioners of the Navy, to be allowed a small vessel in order to visit our various naval stations and there to ascertain the actual dip of the needle by experiment. This permission was most readily and cordially given by that honourable board, to whom both on this and on other occasions I am highly indebted; and Commissioner Cunningham, of Woolwich yard, having received directions to appoint a vessel; he, in the most handsome manner, though necessarily with some personal inconvenience, appropriated to this service the Thames long-boat, a vessel possessing every accommodation that could conduce to my convenience and comfort.

Thus provided, I visited all our naval establishments in the Channel, and ascertained the dip of the needle at each, as well as at several other prominent points; but I found the difference in the dip so very small as to render any correction for it perfectly unnecessary; consequently, the plate and table alluded to above, will answer for any port in the British Channel. Whether there be any sensible increase of dip in our northern ports, is a question which can only be answered by means similar to those above described, that is, by actual experiment.

The instrument which I employed in making these observations was an excellent dipping-needle, constructed by Mr. Jones, Mathematical Instrument-maker to the Ordnance, who very obligingly favoured me with the loan of it for the above purpose.

Note 5.

Some readers will perhaps form a better idea of the principles of the method I have endeavoured to describe, by the representation and description of the model which I have the honour of presenting to the Society, and of which figures 5, and 6 are an elevation and plan. T T is a table, in which is fixed an upright spindle S *s*, which passes through the vessel, and about which it may be turned in any direction at pleasure; D is a brass plate fixed on the deck of the vessel, and divided according to the points of the Compass, the North and South points being fore and aft. H is a hand, or index, moveable on the spindle; C is the compass, P the correcting plate, and R the rod by which it is attached to the pedestal of the compass. The dotted line passing obliquely downwards from C is that in which the centre of attraction of all the guns, and of the other articles of iron contained in the model falls, and in this line the centre of attraction of the plate P is also situated, and at such a distance from C that its power on the needle is equal to that of all the other iron at a greater distance in the same time. Now, to illustrate the nature of the correction by the model, turn it about on its pivot, till the compass shows north, that is, till the lubber-line in the brass compass box and the north of the card coincide; the vessel is then in the meridian, and the moveable index on deck must be set also to point north.

Turn now the vessel on its spindle, till the hand is directed to any other point (as, for example, East): then, if there were no attraction from the iron on board, the compass would show East also; but it will be found to point about E. $\frac{1}{2}$ N., which shows the attraction at that point to be about $5\frac{1}{2}$ deg.;

and in the same way the attraction at any other point may be observed, the plate during such time being removed; and if at any of those points the plate be applied, it will be found to double the quantity of the error.

To illustrate its application in real practice, turn the vessel about (having first adjusted it), till the apparent course by compass, is east, or any other proposed point, without regarding the index on deck; and now, to find the true course, apply the plate, and observe how many degrees, &c. it attracts the needle, which in the model, at east, will be found about half a point, so that the apparent course by compass will be now E. $\frac{1}{2}$ N., the attraction of the plate having drawn the north end forward about $5\frac{1}{2}$ deg. or a half point. The iron of the vessel had therefore done the same before the plate was applied; consequently, the true course was E. $\frac{1}{2}$ S., and by looking to the index on deck, it will be found that this is actually the course shown. The same will be the case at any other point, except that the quantity of attraction will be different, being most at those points towards the east and west, and less as we approach the meridian. In other parts of the world, however, the east and west will be the points of least attraction, and the greatest will be at the N. E., N. W., S. E. and S. W.; but still the plate will always continue to give the same attraction as the vessel, and will therefore in all places furnish a ready method of correction.

The accurate action of a model is seldom to be expected, and less perhaps in magnetical experiments than in any others. I was therefore very agreeably surprised to find how very correctly this model answered all the conditions which I had found to obtain in the largest vessels.

It will be seen in the summary given in Note 1, that the power of attraction, or rather the tangent of the angle of

deviation, at different distances, is reciprocally as the cube of those distances, and that the tangents of the angles of deviation, are also proportional (directly) as the cube of the like linear dimensions of similar masses; if, therefore (as in the model), the magnitudes of the masses are proportional to the general dimensions, the deviations ought to be analogous, and even equal to those in a vessel at large; and a few experiments on the model will show that this is not merely the case theoretically, but that practically the agreement is much closer than could possibly have been anticipated.

N° IV.

IMPROVED BULLET-MOULD.

The small or VULCAN SILVER MEDAL *was this Session voted to Mr.* EZEKIEL BAKER, *of Whitechapel-Road, London, for an* IMPROVED MOULD AND NIPPER FOR BULLETS. *The following communication has been received on the subject from Mr.* B., *and the Instrument has been placed in the Repository of the Society.*

24, Whitechapel-road,
SIR; Feb. 8, 1821.

I TAKE leave to request you will lay before the Society, for the Encouragement of Arts, &c. a new invented Bullet Mould, which, after infinite labour and very considerable expense, I have brought to perfection; and in claiming the merit of the invention, I trust the following explanation of the improvement will be satisfactory to the Society:

First, The mould has a much larger countersink on the top, and of course holds a greater quantity of melted lead, which, as it sinks in the mould, prevents that hollowness which is generally found in balls cast from moulds in the usual way, and consequently renders them far superior.

Secondly, The steel-cutter on the top of the mould is a considerable improvement on the old cutter, as will be instantly seen by cutting off the castable, or neck of a ball,

with each of the cutters. My invention consists in taking off the castable quite clean at once, and at the same time preserving the globular shape of the ball; consequently, the labour and time which were formerly devoted to nipping and trimming, or filing off the exuberance, are now by this method entirely saved, and the ball at one motion is made quite perfect. The double advantage of cutting the balls true in so expeditious a manner, and rendering the balls themselves more perfect, must be instantly perceptible, and I trust will meet the approbation of the Society, who must be aware of the essential importance of the invention to all fire-arms, but more particularly so to rifle barrels, which require the greatest accuracy.

Thirdly, Against the cutter is placed a small cup to hold the ball, which renders the process of cutting off the neck more easy and expeditious.

Fourthly, Under the mould is placed a solid stud, for the purpose of being screwed in a vice, when opportunity offers, by which the balls will be cut easier, and much faster than when simply held in the hand.

Having thus briefly described the new mould, and explained the advantages of the invention, I have to request you will submit it to the inspection of the Society, as I am most anxious to receive their approval before I offer it to public notice. I will not detain you longer by recapitulating the advantages I should individually have experienced by an earlier discovery, nor the labour and expense which would have been saved by its adoption, but shall be happy to furnish any additional information that may be required by the Society, and have the honour to subscribe myself,

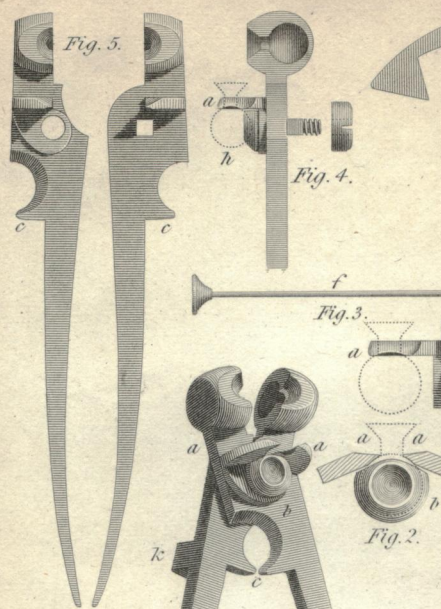
Sir,

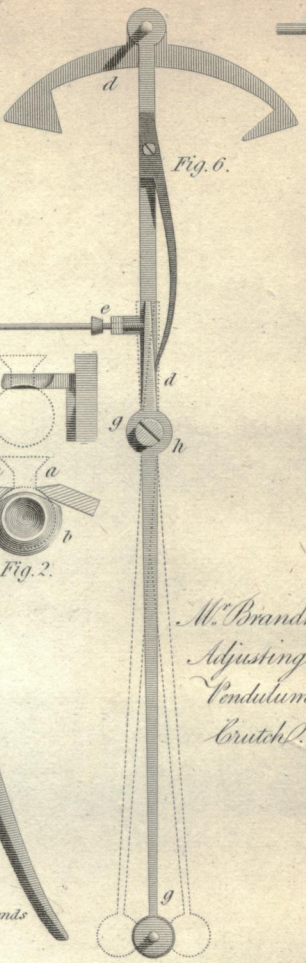
A. Aikin, Esq. &c. &c. &c.

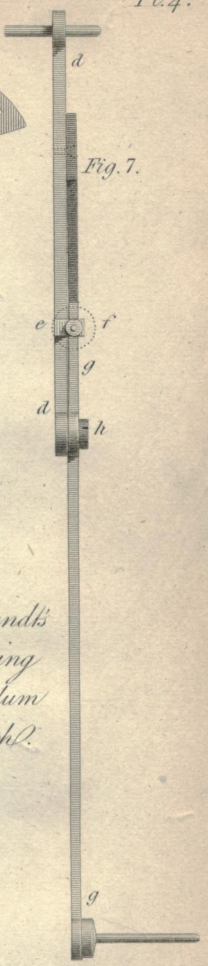
Secretary, &c. &c. EZEKIEL BAKER.

Mr. Baker's Bullet Mould & Nipper.

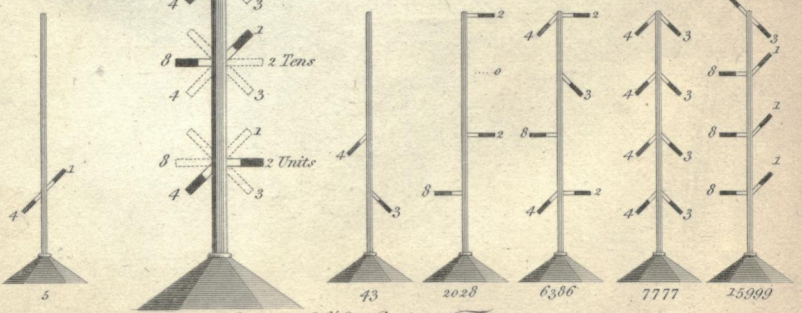
Pl. 4.







Mr. Brandt's Adjusting Pendulum Crutch.



Lieut.t N. H. Nicolas.s Telegraph.

Drawn by Cornelius Varley.

Engraved by G. Gladwin.

Reference to the figures of Mr. BAKER'S *Bullet-Mould and Nippers*, Plate IV.

FIG. 1, the bullet-mould entire; *a a*, the nippers of a curvilinear figure; *b*, a spherical depression, formed in the head of the screw-rivet which connects the two halves of the instrument, and correctly concentric with the axis of the rivet. The nippers and rivet are placed so near to each other, that the globular tool employed to form the depression, at the same time forms a hollow of similar curvature on the face of the nippers. This construction is more obvious in figures 2 and 3, in which the dotted lines represent the ball with its castable; *c* are nippers on the old plan.

Fig. 4 is a lateral view, showing the great width of the countersink through which the lead is poured into the mould, and also the screw-rivet which forms the axis of motion.

Fig. 5 represents the two halves of the instrument detached from each other.

It is obvious, that when the castable is removed by means of the common cutter, which may be considered as a plane acting in the direction of a tangent to the spherical surface of the ball, a portion of the castable will be left behind, thus rendering a greater degree of windage necessary, and, in the same proportion, shortening the range of the ball. This defect appears to be avoided in the use of Mr. Baker's new cutter, which acts in an arc of a circle, of which the middle of the ball itself may be considered as the centre.

N° V.

IMPROVED SEMAPHORE.

The large SILVER MEDAL *of the Society was this Session voted to* NICOLAS HARRIS NICOLAS, *Esq. of the Inner Temple, for an Improvement on the* VERTICAL SEMAPHORE, *and for his method of adapting a shifting Key to Telegraphic Communications, for the purpose of insuring their Secrecy. A Model of Mr.* N.*'s Semaphore has been placed in the Repository of the Society.*

THE vertical Semaphore of Lieut. Nicolas is represented in the lower part of Plate IV. It consists of a vertical pole, to which are attached four pairs of arms, or wings, placed at equal distances from each other. Each arm, by means of cords, or appropriate machinery, is to be made capable of remaining in a vertical, oblique, or horizontal position, the value of each position or number indicated thereby, being that marked in the engraving. The lower pair of arms shows units, the next above shows tens, the next hundreds, and the

upper pair thousands. In the three lower pairs only nine changes are required; and these, as is manifest from inspection, require only five positions. Thus, to display figure 1, the right arm is elevated to the position marked 1, and the left arm is dropped behind the mast, so as to become invisible: in a similar manner 2, 3, and 4 are displayed. N^{os} 5, 6, and 7 require the exhibition of both arms, the left one being in the position 4, and the right one brought into the position 1, 2, or 3, as required. N° 8 requires the exhibition of the left arm alone, and N° 9 requires both arms. The upper pair, by means of six positions, indicates all numbers from one to sixteen, so that a single exhibition of this semaphore will give the entire series from 1 to 16999, being a range amply sufficient for all telegraphic purposes.*

The Shifting Key.

The utility of a secret mode of communicating a message by telegraph, must be so obvious, that it would be needless to point out its advantages.

The idea on which the following method is formed, was suggested by the secret cipher used by Buonaparté; and as that was proved to be efficacious, it is hoped that the arrangement of one on a similar plan, adapted for telegraphic purposes, will not be entirely without utility.

* Although this invention is no doubt original with Lieutenant Nicolas, yet it is but justice to Colonel Macdonald, to observe, that precisely the same principle of indicating units, tens, and hundreds, by separate pairs of arms, on the same mast, is contained in fig. ix. in that officer's Treatise on Telegraphic Communication, published in 1817.

It is to be remarked, that the figures in any part of the Table may be changed, by placing the lines on sliding pieces of paper, like a perpetual almanack; but it would perhaps be sufficient, if the index line of large figures should alone be moveable. If the others are so, care must be taken, that the same figure is not repeated within any two horizontal lines.

Table.

1	1	2	3	4	5
2	6	7	8	9	*
3	1	2	3	4	5
4	*	6	7	8	9
5	1	2	3	4	5
6	9	*	6	7	8
7	1	2	3	4	5
8	8	9	*	6	7
9	1	2	3	4	5
*	7	8	9	*	6

In using this table, any number may be the key, and can be changed at pleasure.

Suppose the key, for example, to be the day of the month, multiplied by 172, the day the 23rd, and the figures of the Table in regular rotation. The real key will become 3784, and it is to be thus used:

Let the real numbers to be signalized be 6764—5398—22—1048—385—4391. Three being the first figure of the key, refer to that figure in the perpendicular line of index

figures in the table; then look for the figure six, the first of the message, in the line of small figures parallel to the former, and the figure immediately below the first figure of the message, is to be noted down. The next figure of the key 7, and the next of the real number 7, being referred to in the same manner, the corresponding figure will be found to be five, which is also to be noted down, and so on, till the key is finished, when it is to be begun anew, and continued till the message is concluded. The most simple way of ascertaining the fictitious numbers is the following:

Key	3784	3784	37	8437	843	7843
Real Numbers	6764	5398*	20*	1048*	385*	4391**
Fictitious Numbers, *i. e.* the numbers to be signalized.	2548	9324*	60*	8081*	349*	6351**

It is to be particularly remarked, that as the introduction of the cipher in the table, would be frequently attended with inconvenience, it is altogether omitted. By attending to the following rule, confusion will not only be prevented, but the arrangement will be more complicated to those who might attempt to decipher a communication without possessing the key. Whenever the omission occurs, the real figure is to be placed amongst the fictitious ones; and in deciphering a message, the omission will indicate that the figure signalized is the real one. In the example, the figures so circumstanced are marked thus*.

To decipher a message, the order of reference must be inverted, by looking for the figure 2, the first of the fictitious number, in the line horizontal to the figure 3, the first of the key in the index perpendicular line of figures, and *that* under

the 2, is to be noted down as the first of the message intended to be conveyed: thus,

Key	3784	3784	37	8437	843	7843
Numbers signalized	2548	9324*	60*	8081*	349*	6351**
Real Numbers . . .	6764	5398*	20*	1048*	385*	4391**

I am, Sir,
&c. &c. &c.
NICOLAS HARRIS NICOLAS.

Inner Temple, Feb. 26, 1821.

N° VI.

SPRING CRUTCH FOR PENDULUMS.

The smaller or Vulcan SILVER MEDAL *was this Session voted to Mr.* C. BRANDT, *of Jermyn-street, London, for an* ADJUSTING CRUTCH FOR CLOCKS. *The following communication has been received from Mr.* B. *on the subject, and a Model of his Invention is placed in the Repository of the Society.*

62, Jermyn-street, St. James's,
SIR; Feb. 8, 1821.

I SHALL feel obliged if you will have the goodness to lay before the Society for the Encouragement of Arts, Manufactures and Commerce, of which I have the honour to be a member, a model of an adjusting crutch for clocks; it is my invention, and the simple, easy, and correct manner by which you may set

a clock in beat, has flattered me that it would be worth the Society's consideration. The difficulty of putting common clocks in beat, is occasioned by the necessity of bending the crutch, which can never be correctly done, whereas this is done by one simple adjusting screw.

I am, Sir,

&c.·&c. &c.

CHARLES BRANDT.

Reference to the Figures of Mr. BRANDT's *Adjusting Crutch,* Plate IV.

THE stem of this crutch is formed of two lengths *d d* and *g g*, figs. 6, and 7 loosely bound together, by means of a screw *h*, the insertion of which is at the lower extremity of the upper piece, and about half an inch below the upper extremity of the lower piece. This latter, therefore, may be considered as a lever, of which the screw is the fulcrum. A moderately strong spring is secured to the upper piece of the stem, so as to act at *d*, on the short arm of the lever, and tending to throw it out of a vertical position. A mill-headed adjusting screw *f* passes through the nut *e*, and thus acts on the lever in a direction opposite to the spring, enabling the artist to obtain precisely the degree of obliquity required to put the clock into true beat.

N°. VII.

SPRING CROSS FOR HORSES.

The small or Vulcan SILVER MEDAL *was this Session voted to* JOSEPH GOODWIN, *Esq. second Clerk of the Stables to his Majesty, for a* SPRING CROSS, *or* BREAK FOR HORSES. *The following communication has been received from Mr.* G. *on the subject, and the Machine has been placed in the Repository of the Society.*

Carlton Palace, April 30,
SIR; 1821.

THE Society of Arts, &c. having been pleased to consider the improvement I have suggested to the Colt-Breaker's Cross worth a place in their valuable volume, I send you a brief account of the advantages I consider to arise from its use, viz. an important auxiliary to the Colt-breaker, in conveying to the animal the first rudiments of mouthing and bitting, and, in some instances, in improving those mouths that have been rendered insensible to the proper use of the bridle.

A cross to obtain these ends is an old invention, though not in general use with colt-breakers; the method adopted by them, is to fasten the bridle reins on the saddle with a cir-

cingle, thus confining the head to a fixed point; and, to lighten them sufficiently, the nose is brought in with the head down towards the breast; in this restrained awkward position the colt fixes his mouth on the bit, bearing hard on it without any change of position for a considerable time together; but on any little relaxation or movement of the mouth, he relapses into the same state again in a few seconds; in this way the mouth is rendered callous and insensible to the proper use of the bridle, and the head is brought too low, and, for the most part, disposed to bear hard and heavy on the hand of the rider or driver.

In order to obviate these inconveniencies, the cross was brought into use; by means of it, the reins were confined at any convenient height above the saddle, which had an advantage over the ordinary method in being able to raise the head and neck to any desirable height. The reins, however, being still a fixed point on the cross, the colt invariably resumed the inconvenient position of the old method. In order to counteract this inconvenience, springs fixed to the cross have been considered a useful expedient; although their employment has been very limited, and in the only instance which has come to my notice was but little calculated to answer the intended purpose. Under these circumstances, I resolved on bringing the machine into a more suitable form. Having done so, if, through the medium of the Society, it should be found as useful generally as it is considered in this establishment, the end I have in view will be obtained.

I wish, however, to be understood, that I do not, in proposing the use of the Spring Cross, anticipate that it is calculated to supersede the skill of the riding-master, it being admitted, that by his aid and delicate handling of the reins, that highly cultivated and sensible state of the horse's mouth, and all

those pliant airs and graceful motions of the body, are only to be obtained.

I am, Sir,

A. Aikin, Esq., &c. &c. &c.

Secretary, &c. &c. J. GOODWIN.

Reference to the Figures of Mr. JOSEPH GOODWIN'*s, Spring Cross, or Break for Horses,* Plate V.

FIG. 1, a front view; fig. 2, a side view, and fig. 3, a bird's-eye view: *a a*, the upper arms of the cross, perforated by loops to allow the play of the reins which pass through them to the springs *c c*; *b b*, guides through which the lower part of the reins pass to the springs *d d*; *e*, a central spring (with a guide staple *f*) to hold the bearing rein; *g g*, the lower ends of the cross to which the girth-bands are fastened. Fig. 4 is a section of the arms *a*, to show how the sides of the perforations or grooves are rounded, to prevent the reins from chafing. In the lower figure the cross is represented as fixed on the horse, from inspection of which it is evident, that though the horse can move his head freely in any direction, he can remain at ease only in that position in which he is required to carry himself.

The figures 1, 2, and 3, are one-twelfth of the real size.

Pl. 5.

Fig. 1.

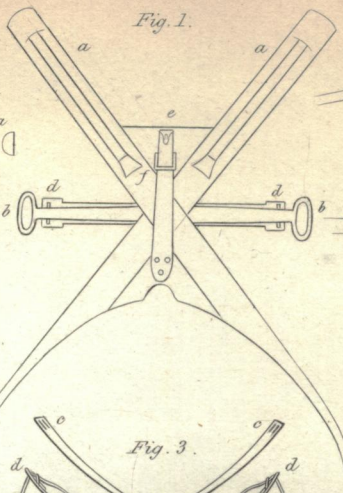


Fig. 4.

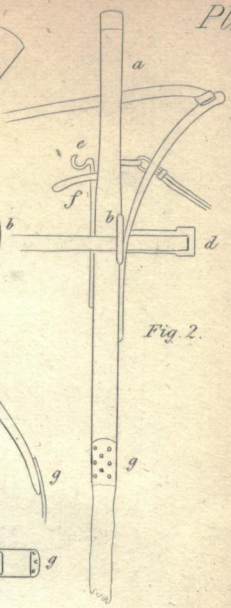
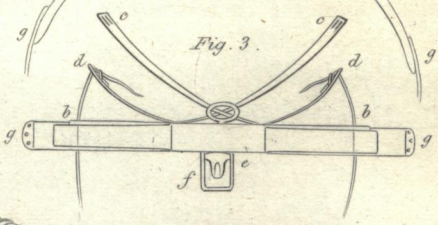
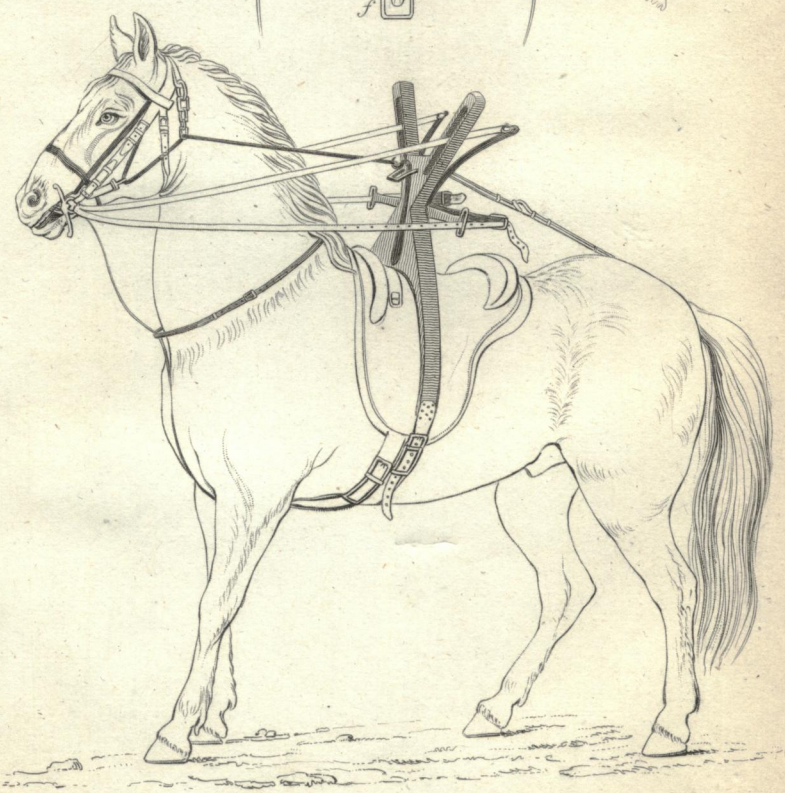


Fig. 2.

Fig. 3.





Mr. Joseph Goodwin's Spring Cross.

Drawn by C. Varley.

Engraved by A.R. Warren.

N° VIII.

BED FOR SURGICAL PATIENTS.

The large GOLD MEDAL *of the Society was this Session voted to* HENRY EARLE, *Esq. of George-street, Hanover-square, Assistant Surgeon at Bartholomew's Hospital, for a* BED FOR PATIENTS UNDER SURGICAL TREATMENT. *The following communication has been received from Mr.* E. *and a Model of the Bed has been placed in the Repository of the Society.*

28, George-street, Hanover-square,
SIR; Feb. 4th, 1821.

YOU will oblige me by submitting the apparatus which will accompany this letter, to the inspection of the members of your Society. It was originally constructed for fractures of the thigh bone, especially when broken at its neck, close to the hip joint, but it has since been adapted to other affections. It will be right here to state, that such accidents are by far the most difficult to treat of any that occur to the human body, and an apparatus has long been wanted, capable of preserving the limb in a state of perfect rest, and maintaining the broken extremities of the bone in close apposition. On no subject, perhaps, is there greater difference of opinion among enlightened surgeons, than the best position and most

approved method of treating fractures of the thigh. This diversity of sentiments is a sufficient proof, that perfection in this department has not yet been attained; but if any additional testimony were required, the numerous unfortunate cripples we daily meet in the streets, would afford abundant evidence. The fact is generally admitted, that no apparatus has hitherto been constructed, to which very material and valid objections may not be made, in particular cases, and under different circumstances, a detail of which, would be quite foreign to the objects of this Society. After premising thus much, it will appear bold in me to suggest any new plan of treatment; yet I flatter myself, that on a careful examination and fair and candid trial, the machine now submitted to your inspection will prove a practical and important improvement. One principal object requisite to the perfect union of broken bones, is uninterrupted rest, and this cannot be obtained in fractures of the upper part of the thigh, where the patient is obliged to be disturbed whenever he obeys the dictates of nature, an objection to which every apparatus hitherto constructed, is more or less liable. This appeared to me, at a very early period of my professional career, to be so great a defect, that I endeavoured to obviate it by inventing a bed for that purpose, for which I received an honorary medal from your Society. Further experience has enabled me to make great improvements, and to render it far more simple, less expensive, and more efficacious. The early fruit of my labours having been fostered by the Society of Arts, I think it but right to offer it to their consideration in its present more mature state. To enter into any discussion on the nature of different fractures, and of the causes which give rise to difficulties in their treatment, would be out of place here; but avoiding as much as possible all technical terms, I may briefly state the principal objects desirable

to be attained in the treatment of fractures of the thighs. In the first place, the pelvis should be immovably fixed; for so central is the hip-joint, that the slightest motion of the trunk is immediately communicated to the upper part of the thigh-bone. Secondly, the position should be the least irksome possible, as patients are often obliged to remain in the same position, without moving for many weeks, or even months together. The position itself should be such as to keep the limb extended to its proper length, and to preserve the fractured part in close apposition, without making any undue pressure on any part, by which painful excoriation and ulceration are often produced. Next, the foot should be supported, so as to prevent it from turning out, from its own gravity or from the pressure of the bed-clothes; and lastly, it is particularly desirable, that the limb should be so placed as to afford every facility to frequent parison with the healthy limb.

The trials to which I have already submitted the accompanying apparatus will warrant me in stating, that it will be found to fulfil all these indications. In the first place, the pelvis will, from its own gravity, remain fixed at the bottom of the angle formed by the superior and central inclined planes, and the aperture made in the central parts, readily admits of the patient relieving himself, and being properly cleansed, without the least movement of either trunk or extremities. Should it be desirable in young persons, or under any particular circumstances, to secure the pelvis more firmly, it will be easily accomplished by two broad straps brought from the edge of the aperture, and passed round the upper and inner part of the thighs, which should cross each other behind the pelvis, and be fixed to buckles at the outer sides of the mattress. This addition will however be rarely required, except in fractures of the neck of the thigh bone. Next as to position, certainly, that on the back on a gently-inclined plane, with

the thighs and legs half bent, and the whole equally and firmly supported on a level surface, is the one which can be the longest endured; and here I may mention, that at the time of my writing this, a patient has been for eight weeks recumbent on one of my beds, who has never once complained of the least uneasiness, but on the contrary, has been perfectly cheerful and happy. Next, the knee being bent over a double inclined plane, affords the best means of making permanent extension, by placing a fulcrum under the ham, and making a lever of the leg, whilst the foot is securely fixed to the foot-board. Thus all the advantages arising from the bent position, namely, the relaxation of the most powerful muscles, and the permanent extension afforded by the straight position, are united, without the patient being subjected to the inconveniences of either, and without the aid of splints or bandages to the broken limb. The gradual curve formed by the mattress, is exactly adapted to the natural arched form of the thigh-bone, and is the least likely to cause any derangement in the length or direction of the broken limb. The fixing of both feet prevents the possibility of moving the pelvis, which a patient is apt to do when one is left at liberty. The juxta position of the limbs affords constant opportunity of minutely comparing them, and of observing whether they exactly correspond. The apparatus for fixing the feet, at the same time supports the bed-clothes and maintains the whole limb in its proper position.

I have stated that this apparatus was first constructed for fractured thighs, but I have since employed it, with marked advantage, in active diseases of the spine; and it is particularly adapted to diseases of the hip-joint, and many other injuries and diseases, where permanent rest is essential to perfect recovery. In applying it to cases of diseased spine, I have added a trap-door and moveable portion of mattress to

the upper inclined plane, similar to the one in the central portion, which is destined for the evacuation of the fæces. The exact situation of this upper aperture, must be regulated by the individual case to be treated, as disease may occur in any part of the spine. This addition will be found most useful in enabling surgeons to apply leeches, and dress issues or setons without at all disturbing the patient, and thus interrupting the reparative efforts of nature. For the additional comfort of those who are capable of mental recreation from study, I have added a swing table and reading desk, which will support a book over the patient's head, without any effort on his part. In constructing this bed, I have as much as possible studied to combine simplicity and economy with convenience and utility. The whole apparatus I have had made by Mr. Cook, of 8, Denmark-street, St. Giles's, for five guineas, and it is probable, that when more have been made, they may be manufactured at even a lower price. In conclusion, I shall take the liberty of strongly recommending its adoption on ship-board, where so much difficulty must necessarily attend the proper treatment of complicated accidents, and gun-shot wounds, where the slightest motion must often renew and render fatal hæmorrhages, which might perhaps be restrained by uninterrupted rest. When the apparatus is not wanted for any accident or disease, the inclined planes may be let down, and it will then form a small commodious bed, not occupying more space than a common hammock. I beg to apologize for the length of this letter, and

am, Sir,
&c. &c. &c.
HENRY EARLE.

P. S. I have declined sending any testimonials in favour of this apparatus, excepting from those medical gentlemen

who have either employed it themselves, or witnessed its application in different cases. I may however state, that I have shown it to many of the most respectable men in the profession, who have all expressed themselves well satisfied with its simplicity, and the prospect it afforded of being extensively useful.

DEAR SIR; Golden-square, March 2, 1821.

I HAVE had great pleasure in examining the bedstead with a double inclined-plane, and have since seen it practically applied to an important case of diseased spine; it appears to me to accomplish the very essential purpose of absolute rest in such cases, as well as those of fractures and other diseases of the upper part of the thigh and pelvis, more completely than any contrivance we have yet had the use of; but the particular advantage it appears to me to afford, is that of allowing the necessary applications to be made, and the necessary discharges removed without disturbing the patient, or the parts whose recovery depends on complete rest.

I remain, Sir,

&c. &c. &c.

T. COPELAND.

Dartmouth, Feb. 24th,
DEAR SIR; 1821.

ALLOW me to express my real and candid opinion of your invention, the double-inclined plane bed. The principle on which it is constructed, and on which it acts, is most excellent for fractures of the bones of the pelvis, for fractures of the thigh, *cervix femoris*, diseases of the hip-joint, as well as diseases and injuries of the spine. It cannot indeed be exceeded whenever uninterrupted rest is required, as by means of the

trap-doors, the alvine and vesical discharges pass off without trouble or inconvenience, sine minimâ aut lecti aut vestis inquinatione; and if setons or issues are required in any part of the back or neck, they can be dressed and kept clean by the same contrivance, without the slightest motion of the patient's body, which is certainly the greatest desideratum in all such cases. When any of the above accidents happen, and patients are placed on a common bed, the fractured limbs are necessarily disturbed whenever the calls of nature occur, to their great injury, oftentimes preventing a nice coaptation of the broken ends of the bones, and thereby frequently causing great deformity of the limb; all this your improved apparatus most completely obviates. It is therefore my decided opinion, founded not only on the instance in which I witnessed your application of it to a near relative of my own, but on the experience which I have since had in my own practice, that when once these beds shall be made known to the faculty, their use will become general.

I remain, Sir,
&c. &c. &c.
W. J. HUNT.

DEAR SIR; Brunswick-square, 17th March, 1821.

I HAVE no hesitation in expressing my decided approbation of your apparatus, for the treatment of fractures of the femur, the efficacy of which I have recently witnessed in a case of the most unfavourable description. It appears to me to afford perfect security against shortening of the limb, and that too with very little inconvenience to the patient; which can be said of no other apparatus, or plan of treatment that has come under my observation.

I remain, Sir,
&c. &c. &c.
G. DARLING.

DEAR SIR; 28, George-street, Hanover-square, Oct. 30th.

As the volume of the Transactions has not yet gone to press, I may perhaps be allowed to address a second letter to you on the subject of my invalid bed. It may perhaps be satisfactory to the members to be apprised, that since my first communication, it has been extensively employed in the wards of St. Bartholomew's, and has essentially contributed to the recovery of several complicated accidents, and compound fractures of the leg and thigh. In diseases of the spine, requiring the use of issues, it has been employed with advantage at the same institution; and at the present time, there are four cases of this description under treatment. It has also been adopted by several other hospitals, and by many practitioners. In my own private practice, I have likewise found it afford the greatest comfort and security; and in one case of diseased spine, by adapting the apparatus to a very easy chariot, I was enabled to remove a patient who had been ten months confined to bed, a distance of one hundred and eighty miles in two days, without her experiencing any inconvenience. To prevent any possible mistake, I shall subjoin some directions to be observed by persons employing this apparatus.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.

Secretary, &c. &c. HENRY EARLE.

Directions for using Mr. EARLE's *Fracture-bed.*

DURING long confinements to bed, particularly when it is necessary to preserve the same position for weeks and even months together, it is of essential importance to the comfort

of the patient, and often to the success of the practitioner, that great attention should be paid to render the bed as permanently level and smooth as possible. This I consider of so much consequence as to merit the attention of the surgeon, who ought never to place a patient under such circumstances on *any* bed, until he has himself minutely examined it. To some gentlemen this may possibly appear unnecessary; but I can practically assure them, that this little preliminary trouble will very often save them much subsequent anxiety and vexation, and mainly contribute to the happiness and comfort of their patients.

In constructing this apparatus, I have bestowed considerable pains in endeavouring to alleviate the sufferings of persons labouring under complicated accidents and diseases; in doing so, however, I have by no means exempted the surgeon from that part of his duty which I have above alluded to, and in the employment of this bed, I would particularly call his attention to the following directions: The mattress should be either of horse-hair, or well stuffed with the best wool, and should be nailed round its edge to the upper division of the frame. A blanket and sheet should be separately strained over the mattress, and carefully sewed all round its edges: this will prevent any subsequent wrinkling, and by sewing first the blanket, and then the sheet, it is obvious that the latter may, if necessary, be detached without at all disturbing the former. The whole apparatus is made narrow, both to facilitate the operations of the surgeon and nurse, in dressing or cleansing the patient, and to prevent him from shifting from the central aperture. Half a blanket, and a single breadth of sheeting will in all cases be sufficient; and in fitting them to the central aperture, as well as the spinal opening when used, it is far better only to make a cross cut from the four corners thus ⋈ than to remove any part.

The loose edges should then be turned down, and sewed at the lower part of the opening. By this plan, any hardness of the edges of the aperture will be avoided.

If the case about to be treated be a compound fracture, and there is a probability of profuse discharge, it will be well to add some oil silk, or a draw sheet, under the part affected. If the case be a disease of the spine, the trap-door and moveable pad should be accurately adapted to the part, before the patient be placed on the bed. In fractures of the lower extremities, the length of the limbs should be taken, and the central portion and foot-board lengthened or shortened accordingly. In complicated cases, where both upper and lower extremities are injured, the addition of the shelf for the support of the arm will be found a great comfort. This was employed with advantage in the case of Turner, who committed the forgery on the Bank of England, who fractured his elbow and hip-joints. The position best adapted for fractures of the thigh, is shown in the right division of figure 1. The same will be found best for affections of the spine and hip-joints.

The position shown in figures 2 and 6, with the lower division horizontal, is the one in which I have placed compound fractures of the leg.

In fractures of the knee-pan, it may be elevated, as shown in the left division of fig. 1, and by the dotted lines in fig. 2, in order to relax the powerful muscles in front of the thigh.

In placing a patient on this apparatus, care must be taken to fix him with the nates directly opposite the central opening, and the nurse should be directed to be very careful to introduce the proper utensil, so as to come in contact with the patient. It occasionally happens, that at first patients experience a difficulty in performing their natural functions in the recumbent position: this will soon be overcome, by raising the upper division a little. In some rare instances, I have

Mr. Henry Earle's Bed for Patients under Surgical Treatment.

Fig. 1.

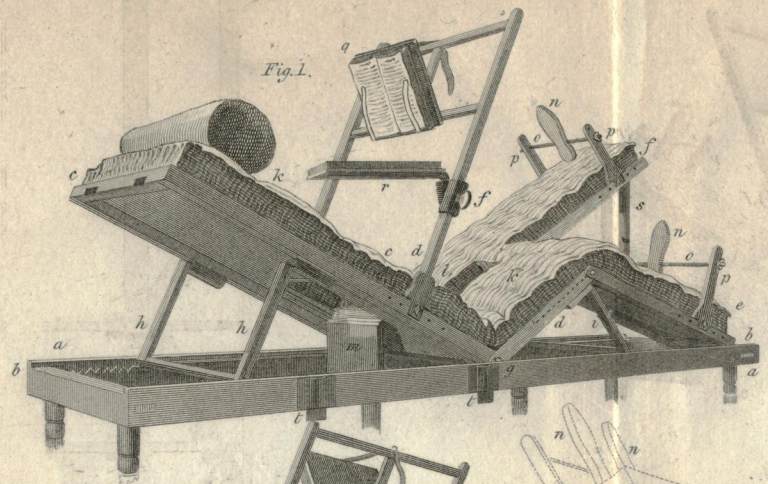


Fig. 2.

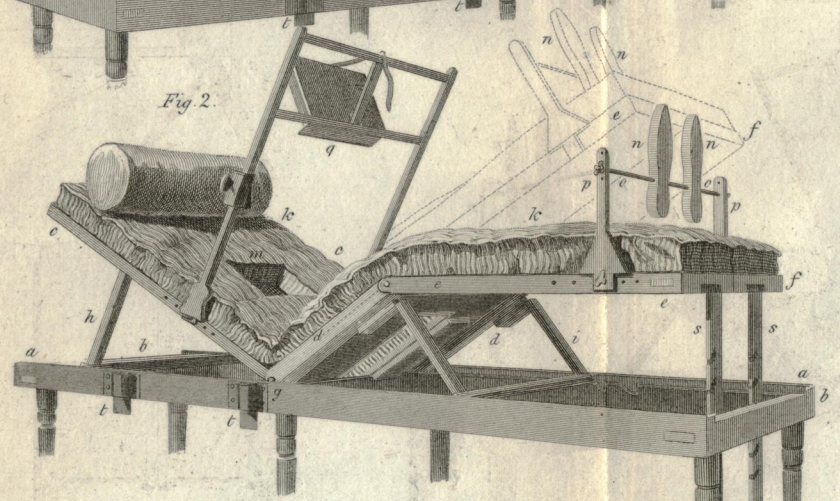


Fig. 3.

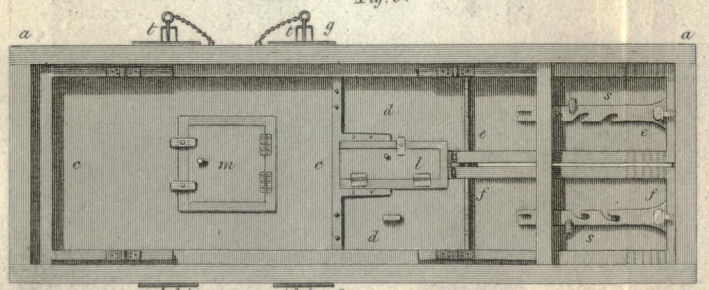


Fig. 4.

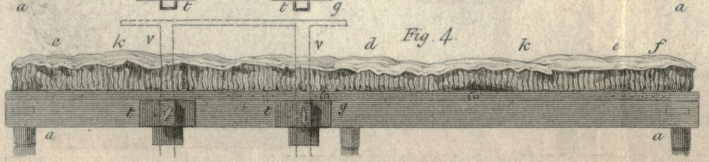


Fig. 7.

Fig. 9.

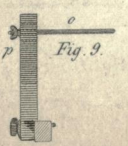


Fig. 6

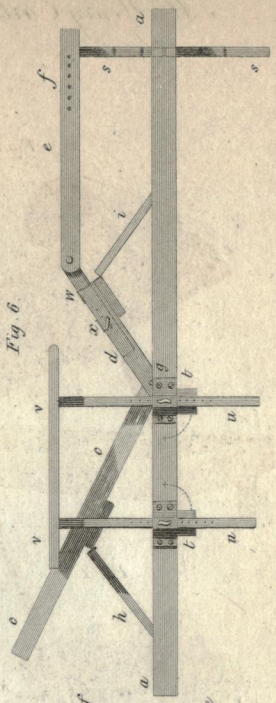
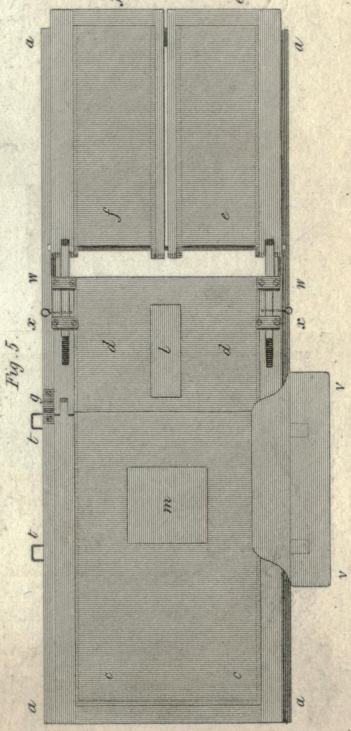


Fig. 5.



Drawn by C. Varley.

Engraved by A.W. Warren.

found it necessary at first to employ a catheter; but this difficulty is far greater when any other apparatus is employed, and, generally speaking, the proper employment of this bed will obviate it altogether.

Description of Mr. EARLE's *Bed for Invalids,* *Plate IX.

THE apparatus consists of a strong fixed frame *a a*, which is rabbeted, as shown at *b b*, figs. 1 and 2, to receive a moveable one of the same length, but about 3 inches narrower. The moveable frame is divided into three parts, connected by joints; the superior one *c c*, is the longer, and is intended to support the head and trunk. The middle division *d d*, which is the shortest, is adapted to the thighs, and is capable of being lengthened, or shortened, as seen at *w x*, figs. 5 and 6. The inferior one *e e*, *f f*, is intended for the legs. This latter part is divided up the middle, for the convenience of varying the position of either leg, as shown in fig. 1. The right division *e e*, is the proper position for fractured thighs; the left division *f f*, for fractures of the knee-pan. The moveable frame is connected with the fixed one, by means of the iron pivots *g g*, which turn in the sockets, which are screwed to the outer frame, at the junction of the upper and middle divisions. Different degrees of elevation may be given to the different divisions by props, one *h h*, under the upper, the other *i i*, under the middle division. These props work in racks at the bottom of the rabbet *b b*, of the fixed frame *a a*. The two portions of the inferior division *e e*, *f f*, are maintained in their different elevations, by means of the wooden uprights or props

* N. B. The letters of reference are the same in all the figures.

s s, which are fixed to the upper frames, by hinges formed with two staples or iron rings. These props are notched at one side, at given distances, and can be dropped upon the screws, which are fixed to the inside of the fixed frame, as best seen in fig. 3. The whole moveable frame is boarded over, and should be bored with numerous gimblet holes to admit air, and prevent the perspiration from rotting the bedding. A well-stuffed hair or wool mattress *k k*, figs. 1, 2, and 4, is fitted to this, which is nailed to the edge of the upper and middle divisions, but left free at the lower division, to enable the apparatus to be fitted to limbs of different lengths. The central division *d d*, has a long narrow trap-door *l*, about $3\frac{1}{4}$ inches wide, and a foot long, which can be let down for the admission of the proper utensils, figs. 7 and 8, fitted to the opening. The mattress at this part has a corresponding vacancy, which is filled up, when not used, by a pad adapted to the opening. A similar trap-door and moveable pad may be made in the superior division at *m*, for the convenience of dressing issues or setons in cases of diseased vertebræ, where the slightest motion of the body should be avoided. The situation of the latter opening, and its length, must vary according to the part affected in the individual to whose case it is adapted; but it should not exceed six or seven inches in width, for fear of taking off too much of the support of the body. When the spine is in a very tender state, the firm pad should be exchanged for a softer one, made with feathers. The rest of the apparatus consists of two pieces of wood *n n*, shaped like the soles of the feet, through which an iron rod *o o*, passes, which is affixed, by two thumb-screws, to two uprights which rest by a broad base on the edge of the inferior division *e f*, and are confined in their situation by screws, which fit into iron plates, with holes at the interval of one inch, to adapt it to legs of different lengths. To these foot-

boards the feet are firmly fixed in fractures of the lower extremities, and in most cases this will supersede the use of splints. A reading-desk *q*, and swing table *r*, have been subjoined for the additional comfort of patients. These are attached to the upper frame, in the same way as the uprights of the foot-boards. The reading-desk will support a book over the patient's head, without any effort on his part, as seen in figs. 1 and 2. On each side of the fixed frame, in figs. 4, 5, and 6, iron sockets *t t*, are affixed to receive the uprights *u u*, which support the shelf *v v*, which is intended to support the arm and fore-arm, in case of a complicated injury to the upper and lower extremities: this may be raised to different elevations, and retained by pins passing through the uprights into the iron sockets.

Fig. 1 shows the apparatus complete, with the reading table. The trap-door for the spine is left open, and the two portions of the inferior division are placed at different elevations; that on the right side is the position for fractured thighs, that on the left for fractured knee-pans.

Fig. 2 gives another view of the apparatus, showing the situation of the central opening, and the inferior division in the horizontal position, adapted to fractures of the leg.

Fig. 3 shows the under side of the apparatus, with a view of the whole mechanism by which it is worked.

Fig. 4 shows the apparatus when not in action.

Fig. 5 gives a view of the upper surface, and shows the mode by which the central division may be lengthened or shortened.

Fig. 6 gives an outline of the frame in the position for fractured legs, with the addition of the shelf for fractured arms.

Fig. 7, the utensil adapted to the size and angle of the central opening.

Fig. 8, urinal for men, particularly in cases of paralysis of the bladder, accompanied with incontinence of urine.

Fig. 9, side view of the upright which supports the foot-board.

N° IX.

ORTHOMETER AND PLEOMETER.

The small or VULCAN GOLD MEDAL *was this Session voted to Mr.* JACOB PERKINS, *of Fleet-street, London, for two instruments for ascertaining the Trim of a Ship more accurately than can be done by the methods usually practised. Models of the instruments are placed in the Repository of the Society.*

69, Fleet-street,
SIR; February 26th, 1821.

IF the Society of Arts will have the goodness to examine two instruments (one of which is denominated an Orthometer, the other a Pleometer), calculated to facilitate the sailing of ships, &c. I shall take great pleasure in submitting them for their inspection.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.

Secretary, &c. &c. JACOB PERKINS.

As the construction of both these instruments is the same, differing only in the relative proportion of the parts, one description will serve for both. The instrument is in fact a mercurial level, consisting of a horizontal tube turned up vertically at each end, to the height of about three inches. This tube or syphon is filled with mercury, so that the fluid rises up about an inch in the two legs, to each of which a float is fixed, forming one end of a lever, as the index does the other end, which is so adjusted that the two indexes are in the same horizontal line when the mercury stands at the same height in both the legs; but when the mercury is unequal, then the indexes are, the one higher and the other as much lower than the horizontal line. Two instruments of this kind being fixed against the side of a ship's cabin, one in the same line with the keel, and the other at right angles to it, will show by changes in the relative position of the indexes, the angular changes in the position of the ship itself, occasioned either by the distribution of the cargo, or by the impulse of the wind on the sails.

The instrument is suspended by two points, one of which is fixed; the other is capable of being raised or lowered by an adjusting screw. As however, from the pitching and rolling of the ship, the mercury would be in a state of constant and violent oscillation, so as to render any accurate observations impossible, the inventor has obviated this difficulty by fixing a perforated screw upon the middle point of the horizontal part of the tube, by means of which the bore in that part can be diminished to any required degree, so as to render the instrument insensible to individual and sudden changes in the position of the ship, while it continues to indicate the average inclination of the vessel.

When the vessel is at sea, and sailing to the most advantage, the adjusting screw of the instrument is to be turned till

the two indexes are brought into the same horizontal line, and this adjustment will ever after continue to indicate the trim of the vessel, as long as no material change in the quantity and position of the cargo takes place. Hence by mere inspection of the instruments so adjusted, the master will know whenever his ship is or is not sailing to the most advantage.

The instrument placed in a line with the keel of the ship is denominated by Mr. Perkins an Orthometer, that placed at right angles to the keel a Pleometer.

Reference to the Figures of the Instruments. Plate VIII.

Fig. 1, front view of the Orthometer; *a a*, front plate which protects and covers the machinery; *b*, screw pin on which the Orthometer is made to swing; *c*, adjusting screw for raising and depressing that end of the instrument to which it is attached; *d*, an aperture cut in the front plate, showing the two indices and the graduated arcs on which they traverse; *e*, the square head of the stop-cock, for regulating the passage of the mercury; *f f*, screws for fixing the floats when the instrument is not in operation, and to prevent the escape of the mercury.

Fig. 2, top view of the Orthometer; *m m*, the back plate in which the machinery is fixed.

Fig. 3, section of the Orthometer; *m m*, the back plate; *g g*, floats resting on quicksilver in the vertical tubes *h h*; *i i*, horizontal connecting tube; *j j*, indices or hands; *e*, regulating stop-cock; *k k*, fulcrums for the index hands; *l l*, screw pins for uniting the lower and upper parts of the instrument; *d*, index plate for denoting the trim of the ship.

Mr. Perkins's Orthometer.

Pl. 8.

Fig. 1.

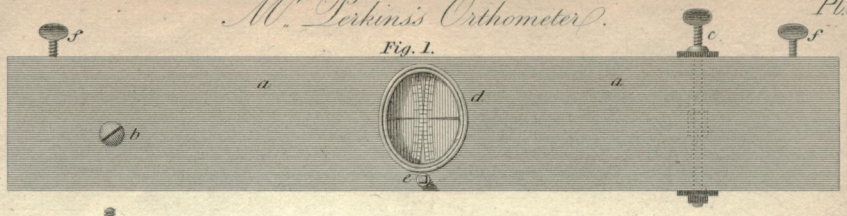


Fig. 2.

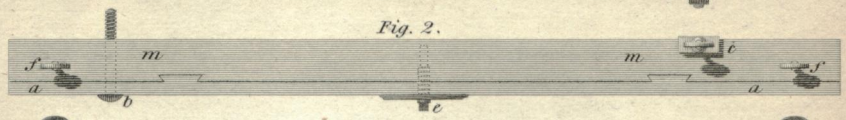


Fig. 3.

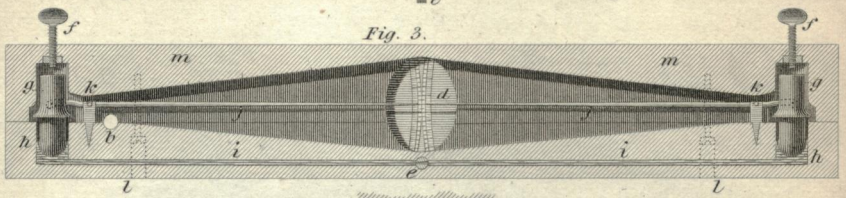


Fig. 4.

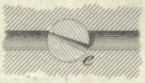
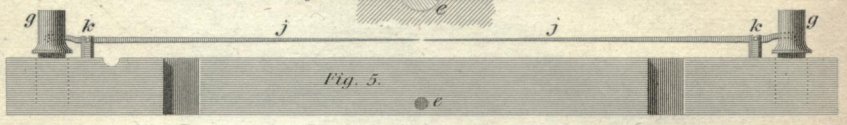


Fig. 5.



Mr. Perkins's Pleometer.

Fig. 7.

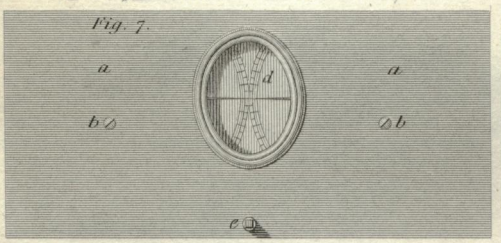


Fig. 8.

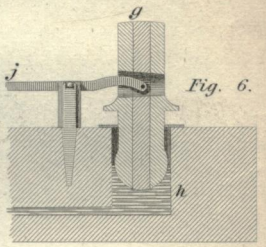
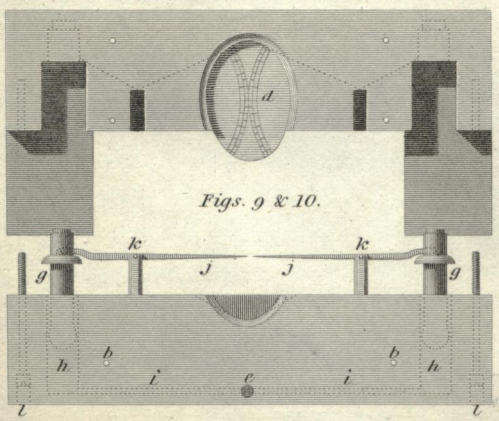


Fig. 6.

Figs. 9 & 10.



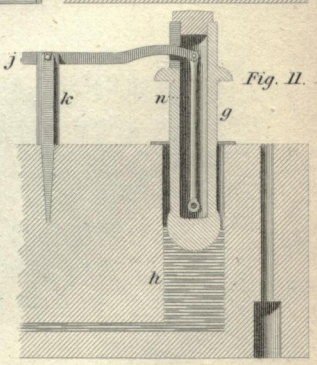
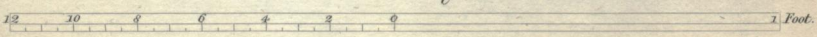


Fig. 11.

Fig. 12.



Drawn by J. Clement.

Engraved by G. Gladwin.

Fig. 4, section showing, on a larger scale, the regulating stop-cock, *e*. The perforation is made conical to allow of more accuracy in its adjustment.

Fig. 5, bottom part of fig. 3.

Fig. 6, section, on an enlarged scale, of part of the Orthometer, showing one of the index hands *j*, and floats *g*, resting on the quicksilver in the vertical tube *h*.

Fig. 7, front view of the Pleometer; *a a*, front plate; *b b*, screw pins to fix the instrument to its place; *e*, regulating stop-cock; *d d*, index plate showing the careen of the ship.

Fig. 8, end view of the Pleometer.

Figs. 9, and 10, view of the Pleometer, the upper and lower parts of the case inclosing the machinery being separated; *g g*, floats for raising and depressing the index hands *j j*; *h h*, vertical tube containing quicksilver; *e*, regulating stop-cock; *i i*, horizontal tube connecting the vertical tubes *h h*; *k k*, fulcrums for the index hands; *d*, index plate; *l l*, connecting screw pins.

Fig. 11, section of one end of the Pleometer, and of part of one of the index hands on a larger scale; *g*, the float resting on the quicksilver in the vertical tube *h*; these floats are hollowed to admit the rods *n* to play therein, and preserve the parallelism of the motion of the floats in the vertical tubes *h h*.

Fig. 12, screw of the regulating stop-cock *e*, full size; *o*, conical aperture, through which the quicksilver flows in its passage from one vertical tube *h* to the other: by turning the screw more or less, the flow of the mercury is regulated so as to partake of the mean motions of the vessel, but not to be continually agitated thereby; and, by turning the screw *e* a little more upwards than is shown in fig. 4, the small conical hole will be entirely closed, and the flow of the mercury prevented.

N° X

FIRE-ESCAPE.

The sum of TEN GUINEAS *was this Session given to Mr.* GEORGE ADAMS WITTY, *of Frances Place Holloway, for a Machine to facilitate* ESCAPE FROM A HOUSE ON FIRE. *A model of the Machine is placed in the Repository of the Society.*

MR. WITTY's fire-escape resembles, when folded up, a small settee, being furnished with arms, cushions, and a cover, all of which are easily removeable, and have nothing to do with the machine when used as a fire-escape. Implements of this kind are generally unsightly, and not applicable to any use except that for which they were primarily intended; the natural consequenee of which is, that they are put out of the way and neglected, so that when wanted on a sudden emergency, they would probably not be forthcoming. It is this consideration which has induced Mr. Witty to convert his Fire-escape into an elegant and convenient article of furniture, the natural position of which would be the recess of a window in a bed-chamber, which is the precise place where, in case of fire, it would be most conveniently used. Plate VI, fig. 1, exhibits the instrument in this state.

Fig. 2 is the seat (without the cover) as removed from the

Mr. G. Witty's Fire Escape.

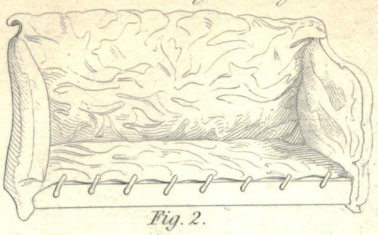


Fig. 2.

Fig. 1.

Fig. 3.

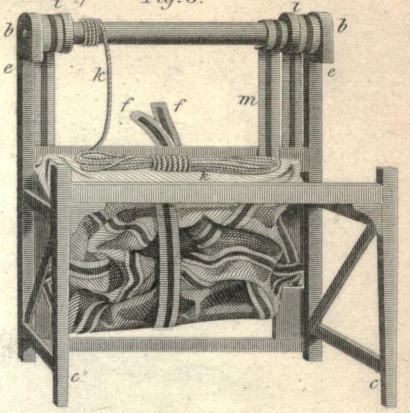


Fig. 4.

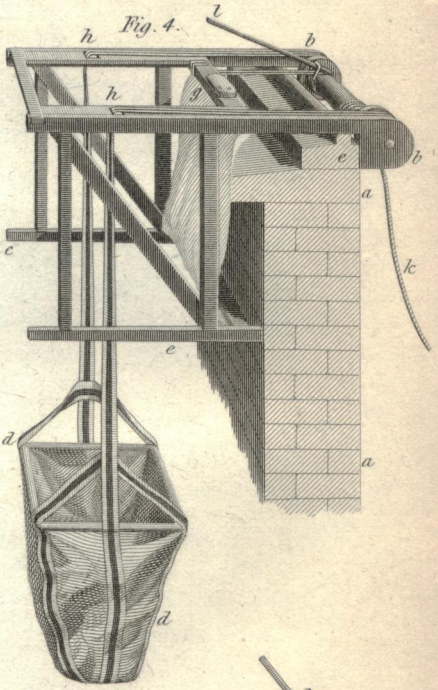


Fig. 5.

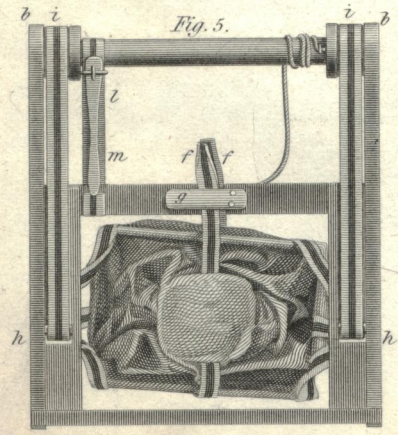
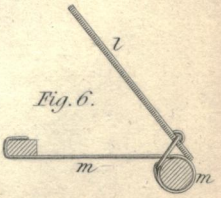


Fig. 6.



Drawn by C. Varley.

Engraved by G. Gladwin.

chair fig. 3, which is now ready to be put out of the window; fig. 4 represents it hanging on the window cill, like the painters machine; *a a*, section of the window cill and wall; *b b* and *c c*, the chair or machine; the top *b b*, which hooks on the window cill, has iron points at *e e*, which, sticking in the cill, prevent the possibility of any accident moving it; *d d* is the bag shown hanging in its place, fig. 4, but packed up in figs. 3 and 5, by means of two straps *f f*, which are fixed at the bottom of the bag, and squeeze tightly under the springing piece of wood *g*; these are pushed out and the bag falls between the frame into its place, as fig. 4; the bag is kept open by being made fast to a strong frame, and well secured by girth-web, which passes under it, and by which it hangs; these webs go over rollers at *h h*, and pass on to the end of the upper roller *i i*, where a sufficient quantity is coiled round to reach from the top of the house to the bottom. When a person gets into the bag, it begins to descend, as in fig. 4, and as the web uncoils itself from the rollers *i i*, it causes the flexible rope *k* to wind round the middle part of the roller *i i*; a person within the room lays hold of this rope to prevent the too rapid descent, and if that is not enough, the handle of the break or regulator *l* is raised by him. Fig. 6 shows the roller *i* in section, with the web *m m*, wrapped round it, and tightened by the lever *l* of the break; the rope *k k* is folded up, and lies at the back of the chair under the seat, as in fig. 3, when not in use.

In case of alarm of fire, take off the seat and cover by the two arms and throw it entirely away from you, it then appears as fig. 3; pull the chair over towards you as it stands, and lift the seat part through the window, the top *b b* which contains the roller *i i* catches withinside the cill of the window-frame, as fig. 4; the chair adjusts itself instantly on the same principle as the painter's machine, and requires no kind

of fixing or fastening whatever, but is perfectly ready for a person to descend, which may be done from a four-story window to the street, in half a minute from the time of getting out of bed. To rescue a family, one person will manage it for the whole. Observe, on putting the machine out, a rope *k* falls at your feet, which winds on the roller as the bag descends; when one person is down, draw the rope, and the bag ascends for another, or two or three children may descend at once; each descent occupying about one minute, a family of twelve persons may be saved in as many minutes: at the right-hand end of the roller is the break or regulator, by merely lifting which, you will prevent the too rapid descent of a great weight; but this is not of importance, as the same may be done by the rope, but not so easily as not affording so much purchase on the roller. When all are down but the person who conducts the machine, he will enter the bag, taking the rope *k* with him, and let himself down; after which, should any one appear at the window, he may, while in the street, draw the bag up to them and let them down; should the bag ever be destroyed after the first descent, the rope (which is a patent one) may be thrown out, and being held by a person at a distance, a descent may be attempted by sliding down it; and should both fail, in the greatest extremity four persons might sit on the machine outside the window, thus affording time to bring fire-ladders, &c. for their relief. In many of the awful calamities that have happened by fire, it is to be lamented there has been no means of saving women and children. The construction of the escape-chair will be found so secure, that the most aged or helpless person that can be got through the window, may be saved by it; and so simple in its operation, that any grown person, male or female, will find no difficulty in the use of it.

GEORGE ADAMS WITTY.

Frances-place, Holloway.

N° XI.

STOVE FOR VENTILATION.

The Thanks of the Society were this Session voted to Mr. JACOB PERKINS *of Fleet-street, London, for his Method of* WARMING AND VENTILATING ROOMS.

THIS communication may be considered as a continuation and improvement of that, by the same candidate, which gained the large Silver Medal of the Society, and is inserted in the last volume of the Transactions, p. 80. The principal improvement indicated in that communication is the introduction of an abundant supply of external air, which, by a very simple apparatus, is brought in contact with the outer surface of the stove, and is thus raised to a moderate and agreeable temperature before it is poured into the room.

In the present plan the horizontal air-trunk remains as before; the stove itself has undergone some modifications, enabling the operator to produce at pleasure an ascending or descending draft through the fuel, by means of the latter of which, the smoke is wholly consumed. The chimney of the stove is surrounded by a vertical air-trunk, fitted with valves in the proper places, by means of which the heated air may be distributed at pleasure to one or more upper floors.

This plan, which theoretically appears very sound, has been carried into practice, on a large scale, with perfect success, at a printing-office in the Old Bailey, in the occupation of Mr. T. C. Hansard, where the ordinary means of producing the required heat, by two fires in each room, had proved insufficient.

The moderate original cost of the apparatus, the considerable saving in fuel, and its very general applicability to workshops and drying houses of every description, have induced the Society to give it a place in the present volume.

Reference to the Engraving of Mr. JACOB PERKINS's, *Warming and Ventilating Stove*, Plate VII.

FIG. 4, section of the stove; *i*, the mouth in which the fuel is put: *k*, the valve or lid to shut it; *l*, the grating hinged at the back, and held up in front by the iron button *m*; *n*, the ash-pit, which is quite close, all but the opening *o*: this is opened and the lid *k* shut while lighting the fire; but when this is done, and the flue *p p* has become warm enough to produce a draught, the valve *o* is shut, and the valve *k* opened more or less, to supply or regulate the draught, by which means the smoke is effectually consumed; the lower part of the flue *p* is spread out at bottom nearly as wide as the stove (as seen in the plan fig. 5); *q q* is an air-trunk supplying fresh air from the outside of the house; this is directed by an iron screen *r r*, so as to impinge on the flue and stove and become effectually warmed as it passes in; *s s* is a hood or trunk surrounding the flue; this draws in much of the fresh air, and conducts it, still hot, through the ceiling into the next floor by the opening *t*, as shown by the arrows; above this opening is

Mr. S. Lake's Hinge. Mr. J. Perkins's Stove. Pl. 7.

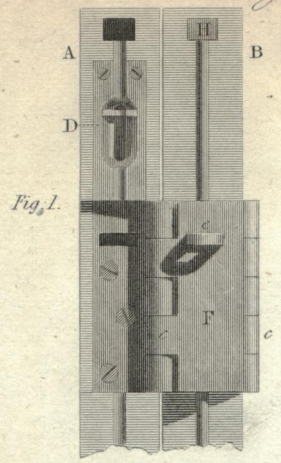


Fig. 1.

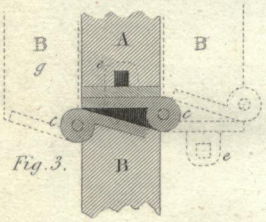


Fig. 3.

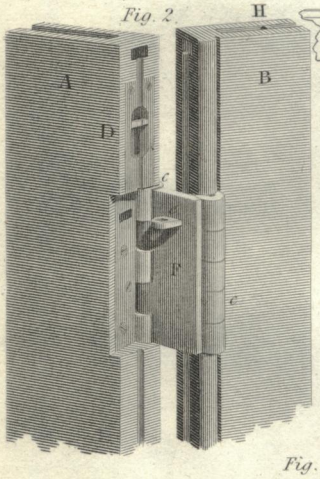


Fig. 2.

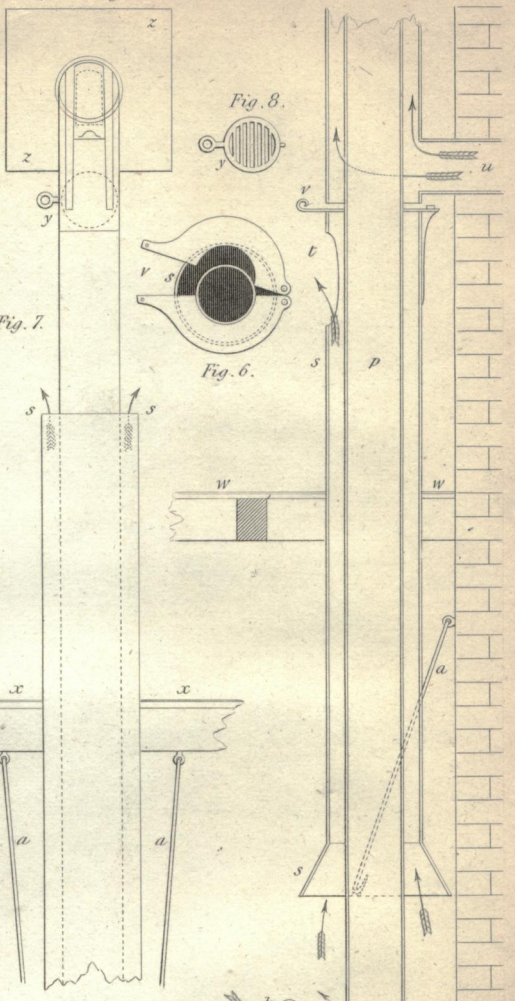


Fig. 4.

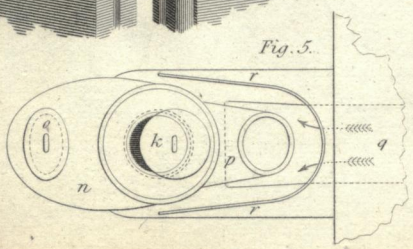


Fig. 5.

Drawn. by Cornelius Varley.

Engraved by William Kelsall.

a register *v*, to stop the air from continuing its course to the third floor; or, if there is too much in the second, to let a portion escape to the third floor (a bird's-eye view, fig. 6, shows this register partly open); when the register *v* is closed another current of fresh air comes in from without through a second air-trunk *u*, and continuing its ascent, comes out warmed at *s s*, fig. 7, into the third floor; *w w;* fig. 4, is the floor of the second room, and *x x*, fig. 7, the third room floor, *y* is a grating or partial damper; it prevents the passage of lighted shavings or paper into the chimney, and is shown separate, fig. 8; *z z*, an iron plate through which the elbow passes into the chimney; there is an opening in the elbow, with a sliding cover; *a a*, figs. 4 and 7, are hooks of iron rod to bear the weight of the trunk *s s*.

N° XII.

DOUBLE DOOR-HINGE.

The small or VULCAN SILVER MEDAL *of the Society was this Session voted to Mr.* SAM. LAKE, *of Alfred-Place, Bedford-Square, for a* DOUBLE DOOR-HINGE, *a Model of which is placed in the Repository of the Society.*

MR. LAKE was employed by Sir J. Lubbock to make a door of communication between two rooms, so as to answer the following conditions: that the door be hung on a single jamb or post, that it be divided into two leaves, so that the outer one,

when necessary, may be folded back flat to the inner one, by turning either to right or left at pleasure, and that the leaves may, on occasion, be fastened together so as to act as a single leaf.

These conditions are fulfilled by Mr. Lake's Door-hinge, and the same contrivance is obviously applicable to a window-shutter.

Reference to the Engraving, Plate VII, Figs. 1, 2, 3.

A B, the middle style of a double-margined door; F, the hinge having two joints *c c*, and consequently three flaps, by which the door will fold on either side, as represented by the dotted lines B on one side, and B *g* on the other side (fig. 3); D, the bolt which, when pushed down, shuts into the staple *e* on the middle flap, and thus fixes one of the joints: the hinge then acts as one on the common construction, and will fold only on the side B *g*; then, by sliding the bolt H (fig. 2) on the top of the door, the double hinge is prevented from acting, the two leaves are secured together in the same plane, and the door opens as a single one, moving only on the hinges attached to the door-post.

Figs. 1 and 2 are elevations; fig. 3 is a horizontal section through the top of the hinge.

Figs. 1 and 3 are $\frac{1}{4}$ of the real size.

N° XIII.

SETTING CUTTING INSTRUMENTS.

The Thanks of the Society were this Session voted to GEORGE REVELEY, *Esq. of Queen-square, London, for a communication on the use of Soap instead of Oil in* SETTING CUTTING INSTRUMENTS ON A HONE.

Queen-square. Bloomsbury,
January 8th, 1821.

SIR;

I BEG to communicate to the Society of Arts, for the benefit of the public, a new method of setting razors by substituting soap instead of oil. Not having any oil to set my razor, it occurred to me to try the soap I was washing with, called palm soap, and I found it so completely to answer my purpose, that I have constantly used it ever since, instead of oil, both for razors and pen-knives. It sets quicker, gives a good edge, and removes notches with great facility; it is a more cleanly material, oil being liable to drop on and soil any thing it comes in contact with; dust will frequently get into oil, which will spoil the edge, and in such case it must be changed. It is as cheap or cheaper than oil, a small square of palm soap costing only three pence, which will last for a great

length of time. The operation is performed as follows: having first cleaned your hone with a spunge, soap, and water, wipe it dry; then dip the soap in some clean soft water, and wetting also the hone, rub the square of soap lightly over it, until the surface is thinly covered all over; then proceed to set in the usual way, keeping the soap sufficiently moist, and adding from time to time a little more soap and water if it should be necessary. Observe the soap is clean and free from dust before you rub it on the hone; if it should not be so, it is easily washed clean; strop the razor after setting, and also again when you put it by, and spunge the hone when you have done with it.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.

Secretary, &c. &c. GEO. REVELEY.

Queen-square, Bloomsbury,

SIR; February 9th, 1821.

I HEREWITH send Certificates respecting my method of setting razors, which also includes workmen's tools; the fact thereby established of setting quicker, is important, as one-fourth in time gained by those who are employed in setting a considerable number of razors, &c. is an object both as to convenience and in saving expense; the excellent state in which it keeps the hone, is also an object both in respect to cleanliness, and the advantage of its surface being kept in a better state for action than when oil is used. With respect to novelty, I only can say I never heard of any one having used it, or received any information from any one on the subject of setting with soap previously to my making the communication to the Society, nor can I learn, on inquiry, that it is known to the

public. You will have the goodness to communicate the contents of this letter, and also of the certificates, to the chairmen and the gentlemen of the Committee of Mechanics.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.
Secretary, &c. &c. GEO. REVELEY.

CERTIFICATES.

SIR; 9, Boswell-court, Queen-square.

I HAVE tried Mr. Reveley's discovery, and am of opinion that the use of soap for the setting of razors, is preferable to that of oil, because they are set quicker, and I think much better; besides, the operation of setting may be performed with a greater degree of cleanliness.

I have set the razors in the following manner: those marked × are set with palm soap, those marked \ with common soap, and those marked // with oil.

A. Aikin, Esq. WM. WEST, *Razor-maker,*
Secretary, &c. &c. *and Working-cutler.*

SIR; Poultry, February 22th, 1821.

AFTER repeated trials of Mr. Reveley's method of setting razors with soap and water, instead of oil upon the hone, I am of opinion that it is much more cleanly and quicker in producing the required edge, and certainly better calculated for the travelling case of an amateur of that useful art.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.
Secretary, &c. &c. W. H. PEPYS.

GENTLEMEN; 217, Holborn, Feb. 23rd, 1821.

BEING an invalid prevents me the honour of attending your Committee this evening, on the subject of Mr. Reveley's employment of soap instead of oil for setting razors, &c.

After having made repeated trials of this new mode of setting razors, I am in candour bound to give it my support; for many purposes it is equal, and in some I think it is superior to the finest oil commonly used for setting cutlery, and edge tools in general.

I am, Gentlemen,
&c. &c. &c.
RICHARD LONG.

55, Southampton-Row,
SIR; Feb. 8th, 1821.

FOR the convenience and advantage which I derive from your kind communication, as to the use of soap in lieu of oil, I beg you will be pleased to accept my sincere thanks. I have almost daily some fresh instance of its utility. My workmen assure me, that in setting their tools, they can do it both quicker and better than with oil.

And in point of cleanliness there is certainly no comparison between the one and the other. Until you kindly informed me of this use of soap, our oil-stone had been a continual nuisance, perpetually daubing and injuring one article or another; but by the adoption of your plan, all this inconvenience has been completely removed.

By widely communicating this truly useful discovery, I am convinced, Sir, you would be rendering an essential benefit to a great number of mechanical trades and would have many thankful acknowledgments from those who are at present unacquainted with it.

I am, Sir,
&c. &c. &c.
ISAAC FREWER, *Saddler.*

In addition to the preceding letters and certificates, it is only necessary to state, that both Mr. West and Mr. Pepys made trial of Mr. Reveley's method in presence of the Committee and to their entire satisfaction.

The saving, in point of time, observed by all who have made comparative trials of oil and soap, will probably be accounted for from the following considerations: If a blade of steel is drawn along a dry hone, certain parts of the hone will be found to be covered by a thin film of steel, abraded from the blade, and now adhering so firmly to the hone, as to prevent its action in the parts thus covered. Having removed the film of steel by means of a pumice stone, and dropping a little oil on the surface of the hone, it will now be found that the abraded particles of steel are suspended in the oil, which thus becomes discoloured, while the whole surface of the hone continues to act on the oil, except where, from the irregularities of the stone or the oblique position of the blade, a thin stratum of oil happens to be interposed. In this case, the tenacity of the oil preventing it from yielding readily to pressure, the blade is apt to slide a considerable distance before it again comes in contact with the surface of the stone. The tenacity of soap and water is by no means equal to that of oil, though capable of holding the abraded particles of steel suspended in it, hence the quantity of effective cutting surface of the hone is increased.

N° XIV.

CUTTING THE DIVISIONS ON CIRCULAR ARCS.

The large SILVER MEDAL *was this Session voted to Mr.* JAMES ALLAN, *of Blewitt's Buildings, London, for his method of* CUTTING THE DIVISIONS ON CIRCULAR ARCS.

IN the Session 1809-10, Mr. Allan received the Gold Medal of the Society for his Mathematical Dividing Engine, in which, besides other peculiarities of construction, his method of cutting, correcting, and equalizing the teeth of the rack, which forms the periphery of the circle, attracted particular notice and observation, not only on account of its novelty, but because it seemed better calculated than any other mode hitherto practised, to insure the utmost possible accuracy of division. A description of this method, with an explanatory plate, is inserted in the 28th Vol. of the Transactions of the Society. The soundness of the judgment thus pronounced by the Society, was most satisfactorily and agreeably confirmed by the Board of Longitude, who, after a very careful examination of the instrument itself, and of its performance, as compared with that of the most celebrated dividing Engines, granted to the ingenious inventor, in 1820, the sum of one hundred pounds, as a testimony of their approbation.

The Society, concurring with the earnest desire of the inventor (now unhappily no more), to give to the public all the peculiarities of construction by which his Dividing Circle is characterized, have now completed their purpose.

The present paper therefore contains a description of the apparatus attached to the cutter, by which the necessity of bounding arcs for regulating the length of the divisional lines, is avoided; and secondly, of the apparatus for stopping the tangent screw, so as to prevent the possibility of any overrunning of the teeth composing the circular rack, and therefore of obviating any inequality from this source in the divisions cut by the engine.

In the usual way of dividing circular limbs of mathematical instruments, the cutter is moved by the hand of the artist, and therefore, to insure the proper length of the lines, three bounding concentric arcs are first described, within which the lines are placed. But even this precaution is not sufficient, unless a magnifier is attached to the cutter, so as to enable the artist to see its point while he is moving it. The consequences of this are, first, a great strain on the eyes from the constant use of the magnifier, and secondly, a great loss of time, not to mention that, as the longer divisions necessarily pass through the intermediate bounding arc, the point of intersection is deeper than the other parts of the line, and the cutter is liable to have its point injured by the kind of trip thus occasioned.

The cutter of Mr. Allan's engine is placed in a kind of cradle-frame, the motions of which are limited by stops actuated by pressing the fingers on two small treadles, by means of which, the length of the lines is regulated with the utmost precision; while an equal depth in the lines is insured by placing ring weights on the cutter, so as to supersede the necessity of pressure by the hand. This contrivance, though

new in its application to the division of arcs, appears to have been in part and occasionally made use of by the late Mr. Harrison, in dividing right-lines.

CERTIFICATES.

19, Newcastle-street, Strand,
March 14th, 1821.

SIR;

In compliance with your wish, I send you my opinion of your new method of cutting mathematical divisions, which I have no doubt is superior to any other hitherto in use; I feel myself justifiable in saying thus much, in consequence of the satisfaction the Theodolites and Sextants you divided for me have given. I do not mean your lines of division, being so nearly in their true places; that has already very justly been noticed and rewarded by the Society of Arts, and Board of Longitude; the present business is your method of cutting those lines, which, in my opinion, does not admit of a question; for every person must, and does know, that when a point cuts lines with a weight or load upon it, the lines will have a greater degree of equality and sameness than when done by the guess and pressure of the hand; the good effect of which is, that the minutes and seconds are much easier read than when there is any inequality in the cutting. I consider likewise that your omission of circular lines is an improvement, because your lines are so exactly of a length that they become a circle themselves, which in point of effect has a more delicate and mathematical appearance, the circular lines being of no other use than a boundary to the divider.

I remain, Sir,

&c. &c. &c.

J. Corless, *Mathematical Instrument-maker.*

SIR ; London, May 2nd, 1820.

HEARING you intend to become a candidate for an additional honorary premium from the Society of Arts, on the subject of your improvement of Mathematical Instruments, I have much pleasure in being able to state, from very considerable experience, the superiority of your method of dividing the limbs of sextants, circles, &c. with uniform delicacy of line, and without circular sweeps.

Your Self-correcting Dividing Engine had formerly insured equal division, and your application of equal pressure in cutting the degrees and minutes, makes every line, and all the lines throughout, of such uniform strength, that I never found any difficulty in reading off the arch to a greater nicety than the vernier was cut to. Thus, in an instrument made to show the arch to 15 seconds, I seldom had any difficulty in ascertaining whether it was one-half, or one-third that quantity more or less ; and in your pocket sextant with tangent screw, cut to 30 seconds, which I have used on many occasions, I could, by taking a mean of 5 sights, determine the sun's altitude, or the moon's apparent distance from the sun or a star to 10 seconds, or less.

Wishing you all the success which your various improvements richly merit,

I am, Sir,

&c. &c. &c.

Jo. TAYLOR, *Chaplain of H. M. S. Spencer.*

Reference to Mr. JAMES ALLAN'*s method of Cutting Mathematical Divisions, by which the concentric bounding circles are omitted*, Plate 10.

IN figures 1 and 2, *w w* is a sextant, in the act of being divided, it is laid on the upper surface of the dividing plate (part of which *a a* is shown), its centre coinciding with that of the dividing plate; *b* is the tangent screw, which, actuated by a cord and treadle in the usual way, and working in the teeth on the edge of the dividing plate, gives a definite motion to the latter at every descent of the treadle, equal to the required distance of the divisions on the sextant, which are marked by the conical pointed cutter *c*. This cutter is suspended in a sort of framing, which secures the true radial direction of the lines marked by it; and the motion of such framing, or elbow-joint as it is termed, is limited by mechanical means, so as to govern, without the application of the workman's eye, the different lengths of lines required to mark the values of the angles they comprehend, as degrees, or minutes, or any quantity of either. The apparatus for this purpose is suspended from a flat bar *d d*, lying across two long bars *e e*, elevated above the dividing plate at one end, by turned pillars, and resting at the other on a transverse bar. The several parts are detailed on a larger scale, that is, one-fourth the real size, in the remaining figures. Fig. 5 is an elevation of the elbow-joint, supposed to be taken looking from the left hand (see figs. 1 and 2) towards the sextant. Fig. 3 is a plan, or bird's-eye view of the same, in which the elbow-joint is concealed by the flat bar before described *d d*, which, it will be seen by the grooves and screws in its ends, has the power of being moved in the direction of the bars *e e*, to accommodate the point of the cutter to the varying radii

Mr. J. Allan's method of cutting Mathematical Divisions.

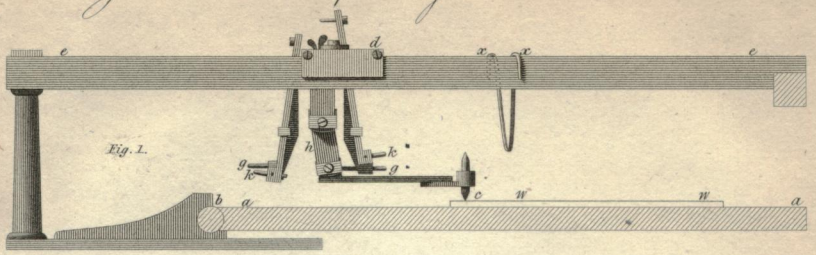


Fig. 1.

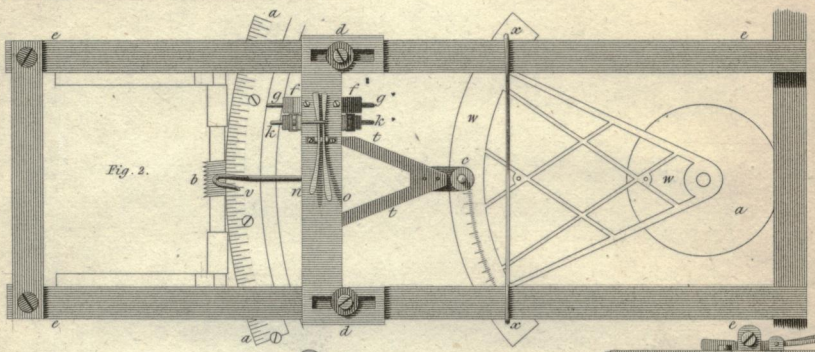


Fig. 2.

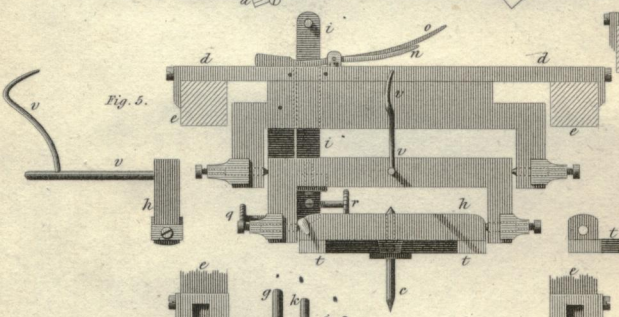


Fig. 5.

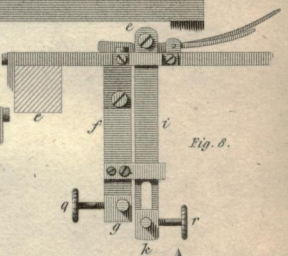


Fig. 8.

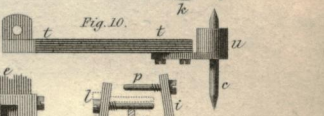


Fig. 10.

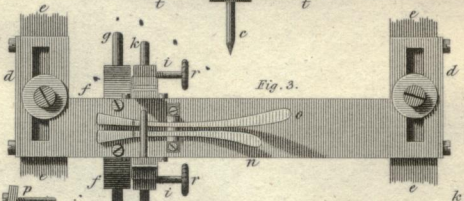


Fig. 3.

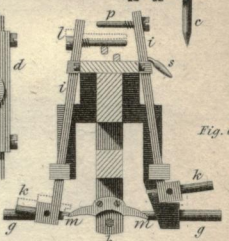


Fig. 6.

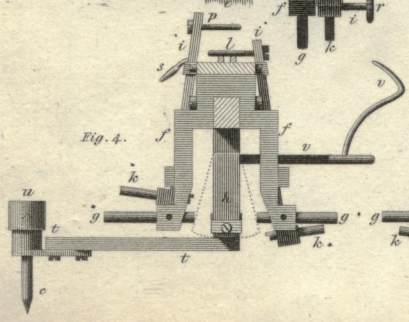


Fig. 4.

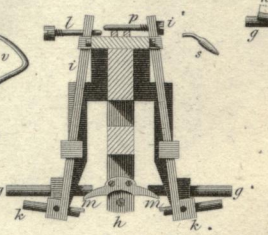


Fig. 9.

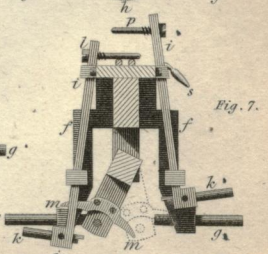
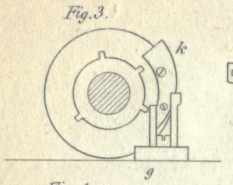


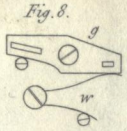
Fig. 7.

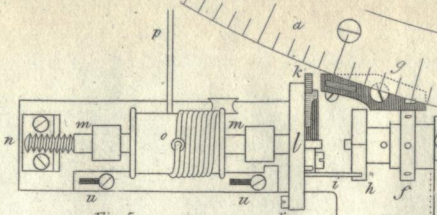
Drawn by C. Varley.

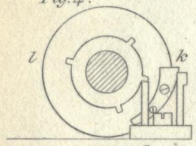
Engraved by J.B. Taylor.

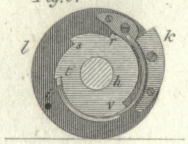
Pl. II.

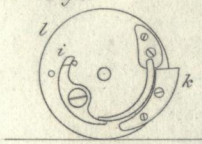


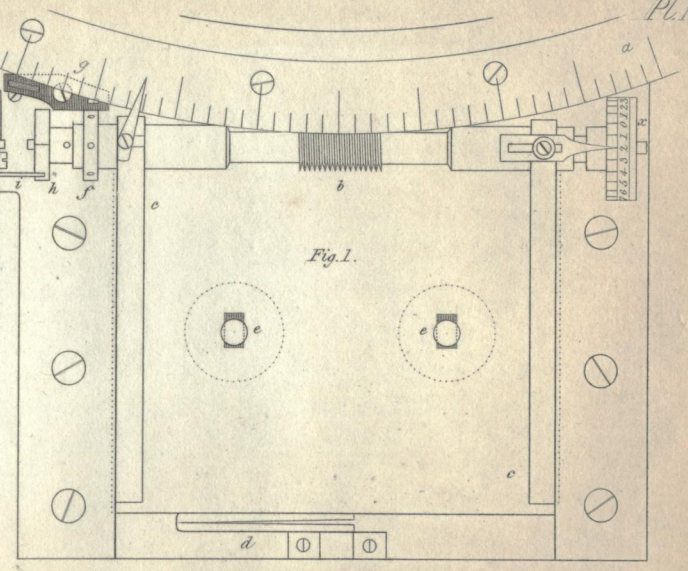




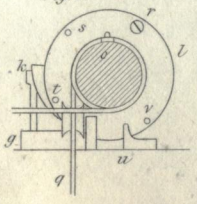


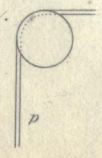


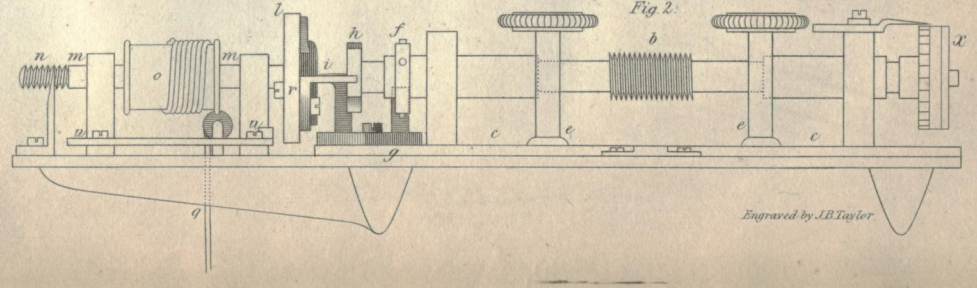




Mr James Allan's method of moving & stopping the tangent screw of his Dividing Engine.







Drawn by C. Varley.

Engraved by J.B. Taylor.

of the instrument to be divided. Figs. 6, 7, 9, are sections of the elbow-joint taken on a line, which may be imagined to pass through the letters *i i*, in figs. 3 and 5, and looking in the same direction as in the elevation, fig. 1. Fig. 4 is a section taken on the line *y y*, fig. 5, and looking in the opposite direction. In fig. 5 it will be seen, that beneath the bar *d*, are suspended three separate pieces of the general form ⌐¬; the upper one is secured to the bar; the two lower ones are hung on screw pivots, so that the lowest has perfect facility of motion in the direction of the radius of the dividing plate, whether horizontal or otherwise, but not the least lateral shake. To the lowest are attached two arms *t t* (see figs. 5, 2, and 4), which meet in a point, at the extremity of which is fixed the cutter *c*. Fig. 10 represents the arms *t t*, and the cutter detached. These parts, comprising what is called the elbow-joint, are in common use, and by the action of the pivot-joints, permit a limited, but amply-sufficient extent of motion in the cutter. The lengths of the lines are governed in Mr. Allan's engine by means of various stops, which limit the swing of the middle portion of the elbow-joint; in fig. 1, this portion will be seen to have reached the limits of its motion towards the right, and in fig. 7 the section of it is described at its greatest recess towards the left; in fig. 4, *h* is the same thing, but not in section, as will be understood from referring to the line *y y* in fig. 5, which will be seen to cut only the upper piece of the elbow-joint, and that in the thinnest part, which will account for the different appearance exhibited in fig. 4, from that in the other sections. Against the sides of the upper piece of the elbow-joint, and at its left extremity, that is, immediately over the return of the middle portion, are fixed pieces *f* and *f*, one on each side; their forms are best identified in the darkly-shaded parts of figs. 7 and 9; in fig. 6, the lower part of

the left-hand one is omitted, for the sake of leaving the other parts more distinct. Through the lower ends of the pieces $f f'$, pass two pins g and g' whose projections may be adjusted and fixed by thumb-screws, shown at q, in figs. 5 and 8. The pins g and g' limit only the extreme motion of the gimbals; the intermediate lengths are determined by puppets, k and k' passing through the lower ends of two inclined pieces, or tumblers i and i'. It must be mentioned, that although there are two tumblers i, and i' and two puppets k and k', only one of each is in action at a time, and either may be removed out of the way of the elbow-joint; as those marked i' and k', are seen to be, in all the figures, except fig. 9; with that exception, i' is described as greatly elevated, and retained by the pin s, which passes through it, and hangs it on to the bar d. The tumblers $i\,i'$ slide up and down in staples, the lower staple to each tumbler being screwed to the pieces $f\,f'$, and the upper ones on the opposite edges of the bar d (see fig. 8). A pair of metal horns $m\ m$ are attached to the elbow-joint for the purpose of stopping against the puppets $k\ k$,' whose projections are adjusted and secured by thumb-screws r, as described, to the pins $g\,g'$; the inner extremities of $k\ k'$ are notched, or stepped, so that as the horns $m\ m'$, which stop the gimbals for the short lines, are received above or below the diameter, the length of the line is greater or less, by exactly the depth of the notch, or step; the requisite elevations of the puppet k, for this purpose are given by two keys n and o, resembling flute keys, placed on the bar d, which play against the under side of the screw pin l, in the head of the tumbler i; pressing the key n, raises k to the height shown in fig. 6, while the key o would place it as shown by the dotted lines in the same figure; thus two lengths of lines are obtained; now let both keys drop, k will sink below the elbow-joint, as in fig. 7, and the elbow-joint will

go on till it stops against the pin *g*, making a third length; but in order to permit this, an aperture is made in the tumbler *i*, immediately above the puppet *k*, through which the horn *m* passes (see figs. 7 and 8), the latter of which (fig. 8) represents one of the pieces *f*, and the tumbler *i*, with their pins, puppets, and thumb-screws as removed from their place in fig. 5, where the three screw-holes for attaching them may be seen. It must not be forgotten, that during this time, *i'* and *k'* have been wholly out of action; the motion of the elbow-joint to the right having been in every case stopped by the pin *g'*, because the lengths of the divisional marks are required to vary only on one side, which variations in the present case (dividing a sextant) are wanted on the side remote from the centre; but in dividing the nonius for the same instrument, the elongated ends of the lines must point towards the centre, to accomplish which, the pin *s* is taken out, the tumbler *i'* and puppet *k'* drop down, and the pin *p*, in the head of the former, falls upon the keys *n o*; the pin *l*, in the head of *i*, being previously withdrawn, the whole will appear in the state of fig. 9; *g* is now the permanent stop to the left, and the lengths to the right are governed by *i'* and *k'*, precisely as already described, in the other direction by *i* and *k*. The motion is given to the cutter, in either case, by the handle *v v*; and the uniform strength of the lines is secured by using any number of ring-weights, as *u*, figs. 4 and 10, with which the cutter is loaded, and which communicate all the requisite pressure. The advantages of these modes of acting on the cutter, namely, by the handle *v v*, and the ring weights *u u*, are, that the hand of the workman is removed to a considerable distance, and the risk of communicating a lateral pressure, or a tremulous motion to the cutter, wholly avoided. A piece of wire *x x*

(see figs. 1 and 2) is suspended from the bars *e e*, and serves to rest the cutter in when out of action.

The pin *p*, in the head of the puppet *i'*, and the thumb-screws *q* and *r*, are omitted in some of the figures, to avoid confusion.

Reference to the Method of moving and stopping the Tangent Screw of Mr. ALLAN'S *Dividing Engine*, Plate XI.

FIGS. 1 and 2, *a a*, part of the dividing plate; *b*, the tangent screw which gives motion to it; *c c*, a sliding plate, which, acted on by the spring *d*, presses the tangent screw against the rack, on the edge of the dividing plate; *e e*, screws which fix the plate *c*, in the place to which the spring impels it, and prevent any unequal action of the spring. Before describing the manner of actuating the tangent screw, it will be requisite briefly to explain what is the defect in the old method, which this invention is intended to obviate; and the engraving here given will assist this object, as far as the parts of Mr. Allan's machinery correspond with those generally used. In figs. 1 and 2, a long axle, or mandril, is seen extending from *n* (a screw) at one end to *x* (a micrometer head) at the other; this axle, or mandril, is in two lengths, the different portions quite detached from, and moving independently of each other. The one part is a continuation of the tangent screw, and comprises all the parts from *h* to *x*; the other portion extends from *n* to *i*, and to this it is that the motion is first given from a treadle, attached to a line *q*, passing several times round the barrel *o*, and then returning to a counteracting weight, attached to the other end of the

line *p*, after passing over a pulley (see fig. 7). By means of a ratchet wheel and click, when this part of the axle is moved, by depressing the treadle, it carries the part containing the screw round with it; but when it returns, by the action of the counter weight, the click slides over the teeth of the ratchet, and the tangent screw stands still. Certain contrivances are attached to the mandril *m m*, which stop its motion at certain points, and consequently regulate the quantity of revolution communicated to the tangent screw; but it will be evident, that although the mandril *m m* cannot go forward without carrying with it the tangent screw, the latter can proceed without the former; and this it is always inclined to do, in obedience to the impetus previously given to it, which the friction of the tangent screw will not in every case overcome. Hence arises an obvious source of error, which is avoided in the present contrivance, by placing the machinery (which stops the revolution of the mandril and the screw in their progress forward) in connection with the axle of the tangent screw itself.

Imagine now the part *m m* to be revolving, not by the descent of the treadle, but by the return of the counter-weight, in which case the driving-wheel *l* will move from *k* towards *r*; the motion will consequently be from *r* to *k*, when the treadle descends, and when the tangent screw is moved. Revolving then from *k* towards *r*, and the screw *n* working in an upright, seen in fig. 2, the whole mandril must recede towards the left, till at last it has receded so far, that the head of the screw *r*, in the back of the driving-wheel, strikes against the sliding bar *u u*, which is attached to the main frame of the instrument, and which having grooves in it, may be made to change its position, and to permit any definite number of revolutions (limited only by the number of the threads in the screw *n*) to be made by the mandril

m m, before the screw *r* shall come in contact with the end of the piece *u*, and stop what is here called the backward motion of the mandril, in distinction from the forward motion in which it carries with it the tangent screw. The movement, when the barrel *o* is impelled by the descent of the treadle, is communicated from *m m* to the tangent screw, by a pin *i*, called the driving pin, which takes into the ratchets of the wheel *h*; but it must be observed, that it is not merely necessary to limit the number of whole revolutions made; it is required most frequently to take portions of a turn, or any number of whole turns, and a certain portion of another, as a half, one-third, or two-thirds; therefore, three of the four teeth which are in the wheel *h*, divide it equally, and the fourth bisecting one of these divisions, the wheel is divided also into two. The wheel *f* has four pins, called stopping pins, projecting from its circumference, distributed exactly as the teeth in the wheel *h*, excepting that they are on the opposite halves of the wheel; or, for example, supposing that the pin which bisects one of the spaces formed by the other three, was at the extremity *f* (see fig. 1) of the horizontal diameter of the pin wheel, then the notch in the ratchet wheel, which in like manner bisects one of the spaces formed by the other three notches, would not be at *h*, but diametrically opposite, and for this reason, because the driving pin *i* always acts on the wheel *h*, at a tooth directly opposite to the stopping pin, which is made to terminate the motion of the screw forward. There is a piece *g*, partly concealed in figs. 1 and 2, and shown separately in fig. 8, which turns round a screw as a centre, has a spring *w*, which plays against one of its ends, and which has proceeding from its upper face (see fig. 2) two perpendicular projections, the right-hand one to receive and check the pins of the stopping wheel, the left-hand one (by means to be hereafter described) to cause the piece *g* to turn on

its centre, and advance the stop at the proper period, under the pins of the stopping wheel. Fig. 5 shows the wheel which carries the driving pin detached; *i* is the driving pin attached to a piece moving on a centre, and retained in its place, that is, in contact with the ratchet wheel *h*, by a spring, which allows it to clear the teeth in returning; *k* is a snail screwed to the face, and projecting beyond the circumference of the wheel. As the wheel *l* advances to the right, by the action of the screw *n*, the snail *k* at last comes in contact with the left-hand projection, from the piece *g*, causes the latter to turn on its centre, and advances the other projection, or the stopping piece under one of the pins of the stopping wheel *f*; fig. 4 describes the snail and the piece *g* exactly in this state; fig. 3 shows them just previous to the commencement of the snail's action. Which of those four pins in the wheel *f* shall stop the motion, and by consequence how large a portion of a circle shall have been completed, whether a half, or one or two-thirds, or whether no fraction shall be included, is determined as follows: the screw *r*, in the back of the wheel *l*, which was described as limiting the returning motion of the mandril *m m*, is received into a hole, of which there are four in the wheel, and into either of which *r* may be inserted; these holes divide the circle like the stopping pins and ratchet teeth already described; they are shewn in fig. 7, *r*, *s*, *t*, and *v*, the screw being in *r*. It is evident that the alteration must be made by changing the situation of the screw in these holes, because the snail must necessarily finish its course in contact with the piece *g*, that is in the situation described in fig. 1 and in fig. 7; and in this latter figure it will be seen, that when the snail is so situated, the hole *v* has just cleared the piece *u*; if therefore the screw was in this hole, the mandril would make whole revolutions; if placed in *r*, it would add a third; if in *s*, a half; if in *t*, two-thirds; the value of these portions

of the circle would, of course, depend on the fineness of the tangent screw; in this engine every revolution of the latter gives one quarter of a degree, one-third of a turn therefore gives five minutes. In fig. 6, the driving pin *i* is shown acting in one of the ratchet teeth, and the driving wheel *l*, and ratchet wheel *h*, appear attached together; this figure, however, only describes their relative positions; it will be recollected, that they are on different axles, though their axes are in the same straight line. The driving-pin *i* is of course required to be of a length somewhat greater than the whole extent of the lateral motion given to the mandril *m m*, by the screw *n*, or it would not retain its hold on the ratchet wheel.

The parts are drawn one-third the real size.